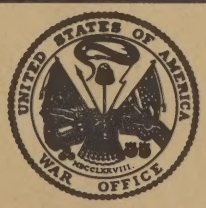
TM 11-6125-225-25

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

MOTOR-GENERATOR PU-573/A



HEADQUARTERS, DEPARTMENT OF THE ARMY
JUNE 1967

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

DON'T TAKE CHANCES!

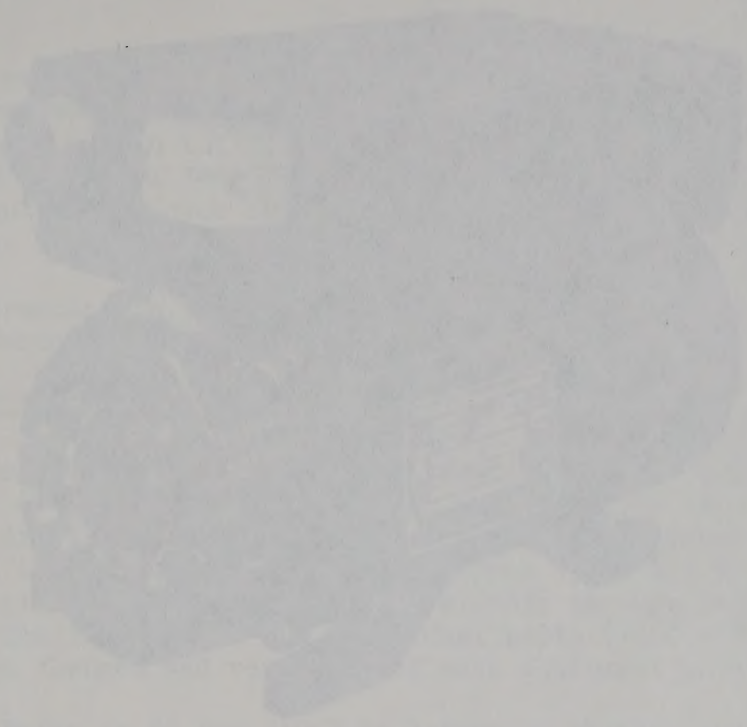
Serious injury or death may result from contact with the 115/200 volts ac output of Motor-Generator PU-573/A. Be extremely cautious when working with the equipment.

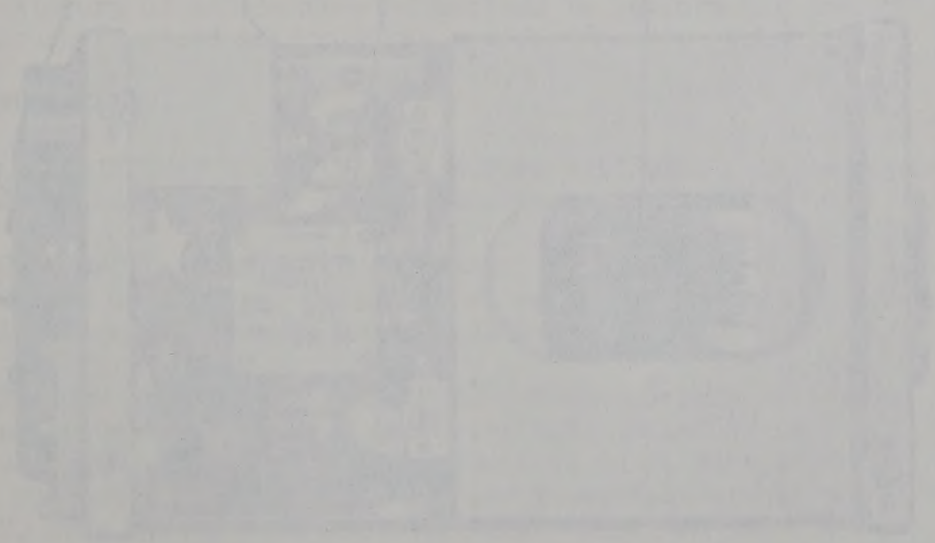
TECHNICAL MANUAL)
)
NO. 11-6125-225-25)

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 5 June 1967

MOTOR-GENERATOR PU-573/A

*This manual supersedes so much of TM 11-6125-225-25P, 21 December 1964, as pertains to Maintenance Allocation, Maintenance Allocation Chart, and Allocation of Tools for Maintenance Functions.





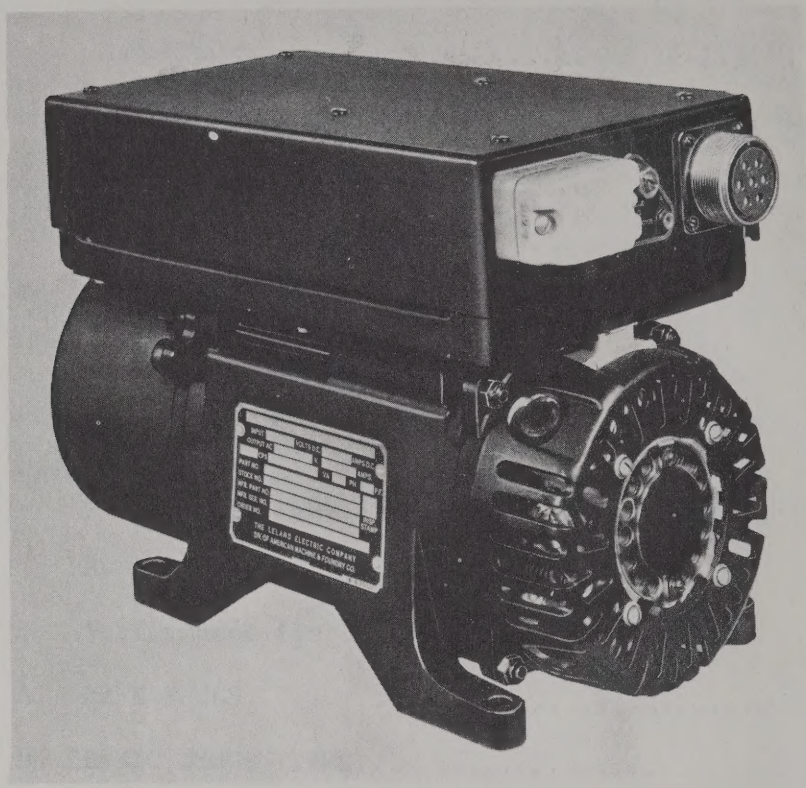


Figure 1-1. PU-573/A Inverter

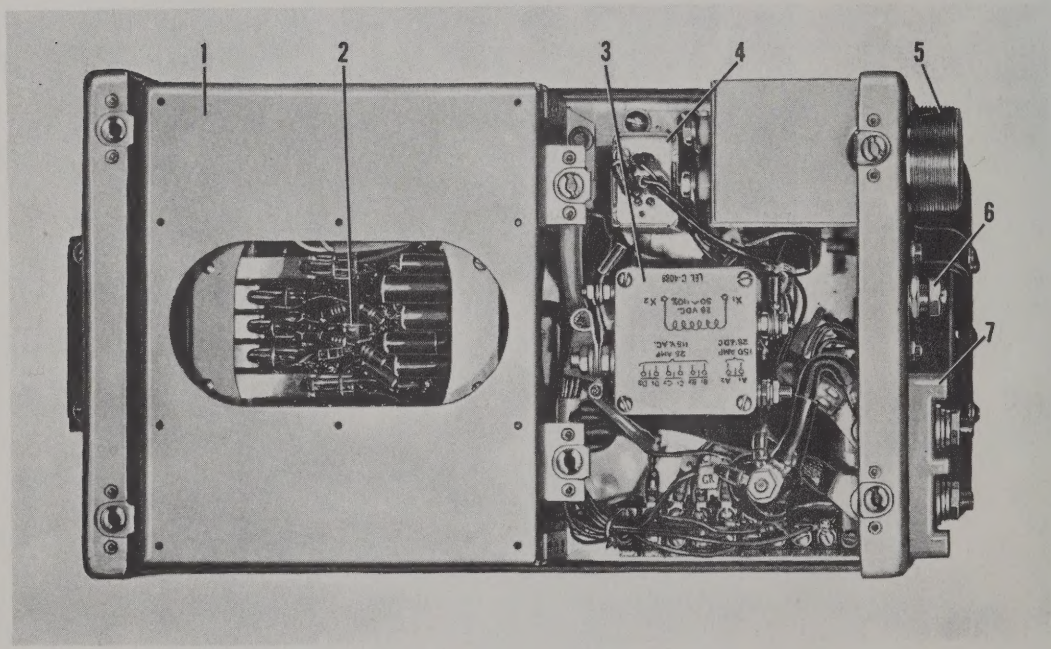


Figure 1-2. Control

1 Voltage and frequency control
2 Rheostat (frequency adjusting)
3 Relay
4 Undervoltage relay
5 Standard connector
6 Rheostat (voltage adjusting)
7 Terminal board

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. GENERAL.

1-2. SCOPE. This manual describes Motor-Generator PU-573/A (fig. 1-1), and provides information on organizational, direct support, general support, and depot maintenance, which includes troubleshooting, testing, repairing the equipment, and replacing maintenance parts. It also lists the tools and test equipment required for each category of maintenance. Appendixes include references, the basic issue items, and maintenance allocation.

NOTE: The information in this manual pertains to inverters supplied by contract No. Air Force 41(608)8846.

1-3. INDEX OF PUBLICATIONS.

a. DA Pam 310-4. Refer to DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. Department of the Army Pamphlet No. 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 7, 8, and 9), supply bulletins, and lubrication orders that are available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes and revisions of each equipment publication.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to this equipment. Department of the Army Pamphlet No. 310-7 lists all authorized Department of the Army modification work orders, identifying the type, model, series, and Federal stock number of the item to be modified; number, date, and classification of the MWO, category of maintenance authorized to perform the modification; and the man-hours required to apply the modification to each item.

1-4. FORMS AND RECORDS.

1-5. REPORTS OF MAINTENANCE AND UNSATISFACTORY EQUIPMENT. Use equipment forms and records in accordance with instructions in TM 38-750.

1-6. REPORT OF DAMAGED OR IMPROPER SHIPMENT. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

1-6.1. REPORTING OF EQUIPMENT MANUAL IMPROVEMENTS. Report of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to: Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-NMP-AD, Fort Monmouth, New Jersey 07703.

1-7. DESCRIPTION. (See figure 1-2.)

1-8. The inverter is a rotary motor-generator with a laminated yoke assembly, having a common shaft for the armature and rotor. The prime mover is a compensated compound wound DC motor having a pole face winding for stabilizing the operation. The speed of the motor is controlled by the electrical circuit of the unit. Rotation is counterclockwise viewed from the commutator end of the inverter.

1-9. The unit is equipped with noise filter circuits in the DC input and AC output lines.

1-10. Two built-in carbon pile amplifiers located in the voltage and frequency control (1) furnish automatic voltage and frequency regulation by controlling the current in the AC rotor winding (for voltage control) and in the shunt field on the motor (for frequency control). An externally adjustable rheostat (6) is also provided to permit manual setting of the AC voltage when the unit is installed. A rheostat (2) is provided for frequency control.

1-11. A relay (3) is provided in the electrical circuit to limit starting current.

1-12. A designation plate is provided below terminal board (7).

1-13. PURPOSE.

1-14. The PU-573/A inverter is an airborne unit used for the conversion of the aircraft's 27.5 VDC power supply to 115 volt, single phase, or 115/200-volts, 3 phase, AC, 400 cycles.

1-15. PRINCIPLES OF OPERATION. (See figures 7-1 and 7-2.)

1-16. The inverter is essentially a motor-generator set, the DC end of which drives the alternator rotor resulting in an AC voltage being induced in the stator windings. Regulation of the output voltage and frequency, under varying conditions of input voltage and output load, is accomplished by means of two separate carbon pile amplifiers; one for voltage and one for frequency. The functions of both amplifiers are closely interrelated.

1-17. The two regulating amplifiers are mounted on a common chassis which is resiliently mounted for vibration isolation within the unit. They are operated from a common power supply. Cooling air is supplied directly from the fan across the amplifier radiators.

1-18. FREQUENCY REGULATION. (See figures 7-1 and 7-2.)

1-19. A relatively low AC voltage is connected to an LC circuit (series resonant at approximately 520 CPS). The LC circuit operates at 400 CPS on the side of the resonance curve. Voltage output across the reactor is rectified by one half of a duodiode tube. Line voltage is impressed on a series RC circuit. The voltage across the condenser is rectified by the other half of the duodiode tube.

1-20. The use of the LC circuit in partial resonance results in a phase shift and a noticeable improvement in wave form. The RC circuit produces a wave form essentially similar to that from the LC circuit and approximately 180 degrees out of phase from the LC circuit.

1-21. Two signals, one positive and one negative, arrive at the rectifier simultaneously and are rectified. The difference in their values represents the grid signal for operation of the 6021 tube and the associated carbon pile amplifier. The amplifier is actuated by two coils. One coil is excited from the DC line through an appropriate resistor. The circuit is "bucked out" as required, by the second circuit which is connected in the tube plate circuit.

1-22. This results in a fail-safe circuit which also has the feature of maintaining high inverter efficiency, since the bucking takes place at a low energy level. The amplifier carbon pile in turn controls the excitation of the shunt field directly from the DC line, thereby controlling the speed as desired.

1-23. VOLTAGE REGULATION.
(See figures 7-1 and 7-2.)

1-24. Output voltage is electronically sensed and amplified. This output voltage is then directly applied to the amplifier actuating coil. Failure of the series filament or the plate circuit will cause failure at low voltage.

1-25. The sensing circuit consists of an emission limited diode tube which functions as the variable arm of a bridge circuit. The changing emission, which accompanies the variation in filament temperature, unbalances the bridge. The resulting output potential actuates the grid of the amplifier tube. This, in turn, controls through the carbon pile amplifier the excitation of the revolving field.

DC INPUT	
Rated voltage	27.5
Maximum input voltage	29.0
Minimum input voltage	26.0
Amperes full load (3 Phase)	178.0
Amperes full load (1 Phase)	190.0
AC OUTPUT	
Single Phase	
Volt amperes	2500
Volts nominal	115
Amperes	21.7
Efficiency (minimum) at unity power factor	47 percent
Three Phase	
Volt amperes	2500
Volts nominal	115/200
Amperes (line)	12.5/7.25
Efficiency (minimum) at unity power factor	50 percent
Range of voltage adjustment	110 to 120 volts (Delta) 190 to 210 volts (Wye)
Power factor	0.90 lag to 0.95 lead
Range of frequency adjustment	390 to 410 cycles
REGULATION (26 to 29 VOLTS INPUT-NO LOAD TO FULL LOAD)	
Single and Three Phase	
Voltage minimum	113
Voltage maximum	117
DUTY (Continuous)	0-50,000 feet, 2500 VA, single or three phase
ROTATION	Counterclockwise, viewed from DC end
ARMATURE SPEED	12,000 RPM
WEIGHT	45.5 LB

Figure 1-3. Leading Particulars

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT.

2-2. The equipment listed in appendix C is required for troubleshooting, testing, and repairing the inverter.

2-3. TOOLS LIST.

2-4. No special tools are required to overhaul this equipment.

2-5. CABLE FABRICATION.

2-6. Lead connections to the inverter for purposes of testing shall be fabricated as outlined in the following:

2-7. Leads to the DC input terminal board shall be insulated copper, American wire gauge NO. 4 and shall not exceed a length that would reduce the input current supply to less than 27.5 VDC at the inverter terminal board.

2-8. Provide an AN3106-24-2P or AN3108-24-2P connector to mate with the inverter connector. Make up the connector with six leads of insulated wire, American wire gauge NO. 14. Leads must not exceed 5 feet.

SECTION III

TROUBLESHOOTING

3-1. GENERAL.

3-2. This section provides information essential for determining the extent of overhaul required and the usability of component parts.

3-3. UNIT TEST.

3-4. Perform the tests as outlined in paragraphs 11-2 through 11-16. Analyze any poor performance as directed below.

3-5. ANALYZING TROUBLE.

3-6. VOLTAGE AND FREQUENCY CONTROL.

3-7. Figure 3-1 outlines the most common conditions and probable defect to look for in checking the voltage and frequency control.

Condition	Probable Defect	Remedy
High output voltage (not regulated)	Tube 6021 (V3) shorted.	Replace.
	Voltage rheostat circuit open.	Repair or replace.
	Transformer secondary winding open.	Replace.
	Tube 6352 (V5) filament open	Replace.
	Sticking voltage carbon pile amplifier or improper adjustment.	Adjust or replace.
Low output voltage (not regulated)	Defective tube 6021 (V3).	Replace.
	Defective tube 6352 (V5).	Replace.
	Voltage carbon pile amplifier sticking or improperly adjusted.	Replace.
	Open voltage carbon pile coil.	Replace.
No output voltage	Open circuit to contact of voltage carbon pile amplifier.	Replace.
	High resistance in carbon pile due to burned carbon pile discs or improper adjustment.	Adjust or replace.
	Tube 5896 (V2 and/or V4) defective.	Replace.
Poor voltage regulation (indicating drift)	Tube 6021 (V3) defective.	Replace.
	Tube 6352 (V5).	Replace.
Poor regulation (no load to full load)	Voltage carbon pile amplifier sticking or improperly adjusted.	Adjust or replace.
	Voltage adjustment rheostat intermittent or dirty contact arm within rheostat.	Replace.
Excessive output frequency (not adjustable)	Frequency amplifier coil (red-yellow leads) open.	Replace.
	Resistor (R-10) open.	Replace.

Figure 3-1. Analyzing Trouble, Voltage and Frequency Control

Condition	Probable Defect	Remedy
Excessive output frequency (not adjustable) (Continued)	Shorted tube 6021 (V3) tube.	Replace.
	Shorted tube 5896 (V1) tube.	Replace.
	Reactor assembly shorted, capacitor to case.	Repair.
	Frequency carbon pile amplifier not adjusted.	Repair or replace.
	Severely damaged frequency carbon pile discs.	Replace.
	Defective tube 5896 (V1).	Replace.
	Defective tube 6021 (V3).	Replace.
Low output frequency (not adjusted)	Tube filament series open preventing normal tube warm up.	Replace.
	Open series resistor in heater circuit.	Replace.
	Defective tube 6021 (V3).	Replace.
	Frequency amplifier contact (blue and white lead) open.	Repair.
Frequency unstable (adjustable)	Defective 5896 (V1) tube.	Replace.
	Reactor assembly capacitor defective.	Replace.
	Frequency adjustment rheostat contact arm dirty or making intermittent contact.	Clean or replace.
	Defective tube 6021 (V3).	Replace.
	Frequency amplifier carbon pile sticking or not adjusted.	Clean and adjust, or replace.
	Intermittent DC supply (5896, V2 and V4 tubes and associated circuit).	Replace.

Figure 3-1. Analyzing Trouble, Voltage and Frequency Control (Continued)

3-8. VOLTAGE, CONTINUITY AND RESISTANCE CHECK.

3-9. For resistance readings, regulator must be disconnected from the motor-generator.

NOTE

All readings are ± 10 percent tolerance to the points charted in figure 3-2.

3-10. For voltage readings make up the lead connections to the internal terminal board of an PU-573/A inverter of known ability. Make up the lead connections as outlined in figure 3-3. All readings are measured from chassis ground unless otherwise specified.

NOTE

Outside case is not at ground potential. The friction plates, located inside the cage assembly, are not insulators but exhibit a resistance value of approximately 15,000 ohms to infinity.

Tube	Terminal	Voltage	Resistance
V1 (5896A)	1	-3VDC	Infinite ohms
	2	33 VDC	390,000 ohms
	3	6.3 VDC	3 ohms
	4	NC	NC
	5	-37 VDC	400,000 ohms
	6	0 VDC	0 ohms
	7	-3 VDC	Infinite ohms
	8	NC	NC
V3 (6021A)	1	125-150 VDC	Infinite ohms
	2	-6 VDC	Infinite ohms
	3	13 VDC	6 ohms
	4	0	0 ohms
	5	0	0 ohms
	6	6.3 VDC	3 ohms
	7	-2 VDC	Infinite ohms
	8	120-140 VDC	Infinite ohms
V2 (5896A)	1	-180 VDC	Infinite ohms

Figure 3-2. Voltage and Resistance Continuity Check

Tube	Terminal	Voltage	Resistance
V2 (5896A) (Continued)	2	145 VAC	210 ohms
	3	21 VDC	17 ohms
	4	NC	NC
	5	145 VAC	210 ohms
	6	27.5 VDC	20 ohms
	7	180 VDC	Infinite ohms
	8	NC	NC
V5 (6352)	1	-180 VDC	Infinite ohms
	2	Not used	-
	3	Not used	-
	4	Not used	-
	5	-5 VDC	Infinite ohms
V5 (6352) (Continued)	6	-180 VDC	Infinite ohms
	7	-5 VDC	Infinite ohms
	8	Not used	
V4 (5896A)	1	-180 VDC	1 megohm
	2	135 VAC	600 ohms
	3	19 VDC	9 ohms
	4	NC	NC
	5	135 VAC	600 ohms
	6	13 VDC	6 ohms
	7	180 VDC	Infinite ohms
	8	NC	NC

Figure 3-2. Voltage and Resistance Continuity Check (Continued)

3-11. Tubes not meeting the values as specified in figure 3-2 must be replaced. Follow the procedures outlined in paragraph 7-4 when replacing components of the voltage and frequency control circuit board assembly.

3-12. MOTOR GENERATOR.

3-13. ANALYZING TROUBLE.

3-14. Figure 3-4 indicates the most common defects to look for in the motor-generator.

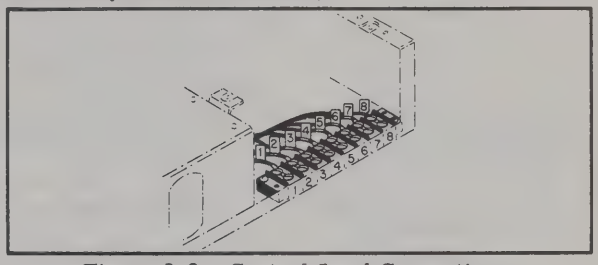


Figure 3-3. Control Lead Connections

Condition	Probable Defect	Remedy
MACHINE WILL NOT COME UP TO SPEED	Defective tubes.	Check tubes and replace.
MACHINE RUNS OVERSPEED	Carbon pile out of adjustment or sticking.	Adjust carbon pile. Clean carbon pile tubes.
	Defective tube.	Check tubes.
ARMATURE WILL NOT ROTATE. NO CURRENT.	DC brushes missing.	Replace brushes.
	No voltage at terminals.	Check power supply
ARMATURE WILL NOT ROTATE AND MACHINE DRAWS EXCESSIVE CURRENT	Bearing failure.	Replace bearings as required.
	Motor shunt field open.	Replace stator.
	Bent or binding armature.	Replace armature.
MACHINE DRAWS EXCESSIVE CURRENT WHILE RUNNING	Motor armature grounded.	Replace armature.
	Motor shunt field grounded.	Replace stator.
MOTOR BRUSHES SPARKING OR ARCING	Brushes worn or broken.	Replace brushes.
	Motor armature grounded.	Replace armature.
	Brushes sticking in holders.	Free brushes and clean holders.
	Raised bar on commutator.	Turn down commutator or replace armature as necessary.
	Brushes not seated.	Run-in brushes, refer to paragraph 7-6.
ALTERNATOR BRUSHES ARCING	Brushes worn or broken.	Replace brushes, turn down slip rings if necessary.

Figure 3-4. Analyzing Trouble, Motor-Generator

Condition	Probable Defect	Remedy
ALTERNATOR BRUSHES ARCING (Continued)	Alternator field grounded.	Replace stator.
	Brushes sticking in holders.	Free brushes and clean holders.
	Slip rings out of round.	Turn down slip rings and check concentricity.
MACHINE NOISY	Bearing defective.	Replace bearings as required.
	Mechanical interference.	Correct as required.
NO AC VOLTAGE AT OUTPUT TERMINALS	Alternator field open or grounded.	Replace stator.
	Alternator stator open.	Replace stator or remove ground.
	Coil of AC output relay, open or grounded.	Replace relay.
CANNOT ADJUST VOLTAGE	Voltage adjusting rheostat defective.	Replace voltage rheostat.
RIPPLE VOLTAGE ON DC LINE TOO HIGH	DC filter failure	Replace filter.
	Brushes out of alignment.	Replace motor end housing assembly.
	New brushes not seated.	Run-in brushes. See paragraph 7-6.
RADIO NOISE LEVEL TOO HIGH	Filter condensor failure.	Replace filter.
	Parts of machine poorly bonded together.	Make sure all fastening and electrical connections are tight. Be sure there is no paint or dirt between machine surfaces.
	Fan rubbing on end shield.	Check to see if shimming of armature is properly accomplished.

Figure 3-4. Analyzing Trouble, Motor-Generator (Continued)

3-15. The manufacturer recommends that the motor-generator be performance checked with the use of a voltage and frequency control of known ability.

a. If no qualified voltage and frequency control is available it will be necessary to provide the following arrangement.

b. Connect a rheostat with a capacity of 50 watts, 100 ohms, in series with a 0-5 amp DC ammeter between terminal "1" of the internal terminal board and ground. This rheostat will control the generated voltage.

c. Connect a rheostat with a capacity of 50 watts, 100 ohms, in series with a 0-5 amp DC ammeter between terminal "1" of the internal terminal board and ground. This rheostat will control the motor speed through the shunt field.

CAUTION

The shunt field must be connected prior to energizing the armature to prevent the machine from running overspeed. Machine overspeed can result in mechanical damage.

d. Refer to paragraph 2-7 and make up the input leads as indicated. Provide a power supply of 27.5 volts DC.

CAUTION

Before starting the motor-generator the shunt field rheostat must be set at minimum value.

3-16. PERFORMANCE CHECK.

a. Connect the inverter to Test Set, Motor-Generator AN/GSM-65 or to load bank and load meters in accordance with figure 11-1 if Test Set, Motor-Generator AN/GSM-65 is not available.

b. Provide power to the motor-generator.

c. If the motor-generator is being checked without the aid of a voltage and frequency control, proceed to make the intermittent value checks by rotating the voltage and frequency rheostats. Compare the readings to those values given in figure 3-5.

d. If the motor-generator is being checked without the aid of a voltage and frequency control, it will be necessary to manually perform the function of the voltage and frequency carbon pile amplifiers. Manipulate the rheostats as installed in paragraphs 3-15, a, b, and c, and note values.

3-17. Motor-generators not meeting the above requirements must be overhauled.

Input Voltage	Output Voltage	Load Watts	Line Current	Shunt Field Current	Rotating Field Current
26	115	0	74 MAX	3.10 to 3.70	1.20 to 1.80
26	115	2500	187 MAX	0.90 to 1.50	2.40 to 3.00
28	115	0	68 MAX	3.30 to 3.90	1.20 to 1.80
28	115	2500	178 MAX	1.70 to 2.30	2.40 to 3.00
29	115	0	66 MAX	3.50 to 4.10	1.20 to 1.80
29	115	2500	173 MAX	2.20 to 2.80	2.40 to 3.00

Figure 3-5. Intermittent Values

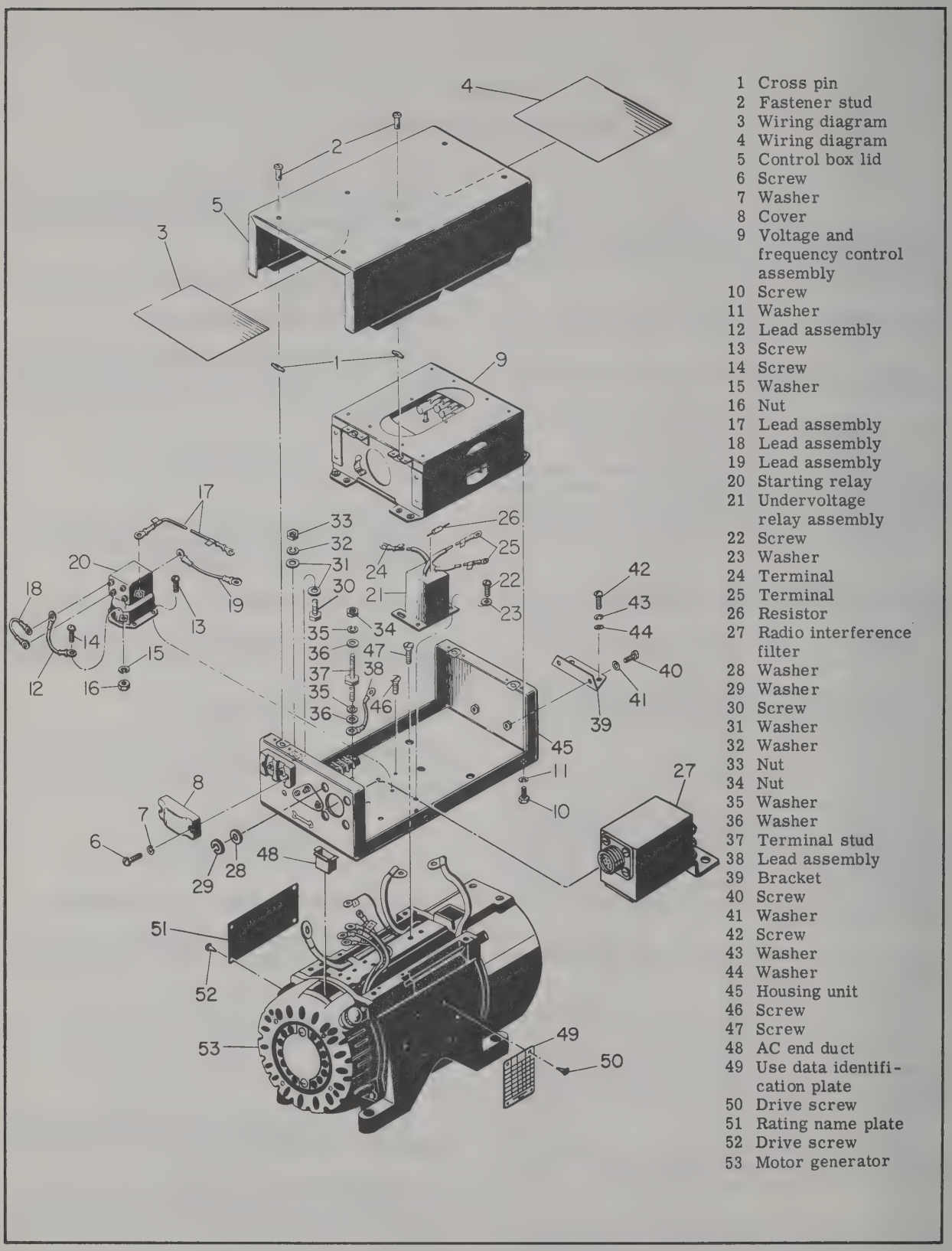


Figure 4-1. Inverter Assembly

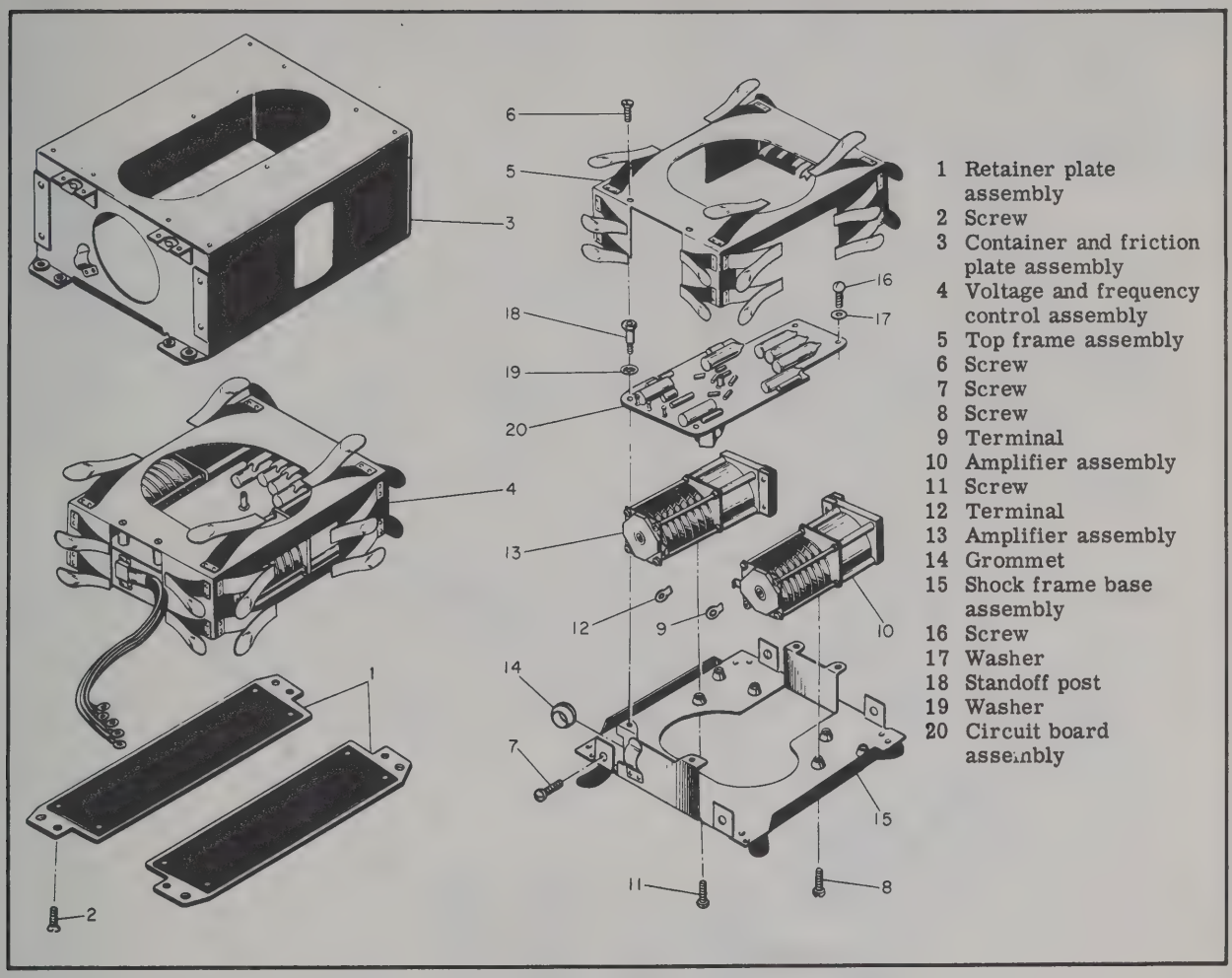


Figure 4-2. Voltage and Frequency Control Assembly

j. Separate the center plate (21), plate and core assembly (23) and remove the coil (22) from the plate and core assembly.

4-7. UNIT HOUSING ASSEMBLY. (See figure 4-5.)

a. Disconnect the leads from the terminal board (3) and marker strip (5) from the housing assembly (35).

b. Remove the hardware and terminal straps (10 and 11) from the terminal board assembly (12).

c. Remove the terminal board assembly from the unit housing (35).

d. Remove capacitor (16) from the unit housing assembly (35).

e. Remove nuts (17 and 18) and washer (19) from rheostat (21) and remove rheostat. Remove connectors (23 and 25) by removing a nut from the rear of each. Also remove instruction plate (26).

f. Remove two screws (28) from capacitor clamp (27) and lift the capacitor (31) out of the unit housing.

g. Remove bracket assembly (32) by removing screw (33).

4-8. MOTOR-GENERATOR. (See figure 4-6.)

a. Remove fan cover (1).

b. Remove four screws (5), lift up on brush springs and remove DC brushes (4) from their brush holders.

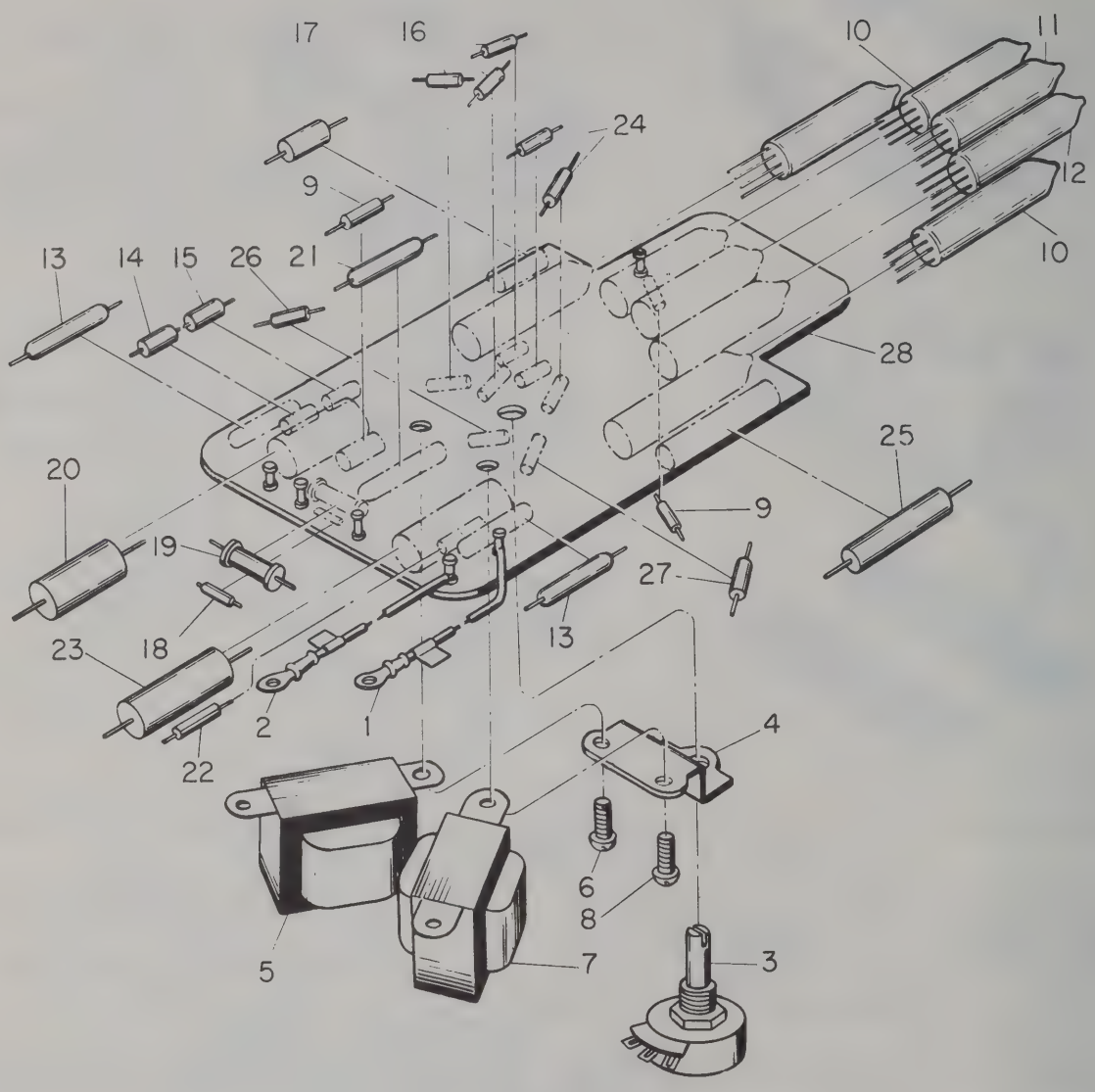
c. Remove the AC end cover (6).

d. Remove four brush holder caps (9) and remove the AC brush assemblies (10 and 11).

e. Remove the lock nut (12), lock washer (13), fan (14), flat key (15) and a fan spacer (16) from the DC end of the armature shaft.

f. Remove the four screws (18). Remove the external bearing plate (17).

g. Remove four thru-bolt screws (22) and nuts (23) from opposite ends of the stator. Free stator leads from the DC end bell unit (21) and remove shield assembly from the stator. Tap the shield several times with a nonmetallic mallet to facilitate removal.



1 Terminal	6 Screw	14 Resistor	21 Capacitor
2 Terminal	7 Transformer	15 Resistor	22 Resistor
3 Variable wire wound resistor	8 Screw	16 Resistor	23 Capacitor
4 Rheostat mounting bracket	9 Capacitor	17 Resistor	24 Resistor
5 Reactor assembly	10 Subminiature tube	18 Resistor	25 Resistor
	11 Subminiature tube	19 Temperature compensating resistor	26 Resistor
	12 Subminiature tube		27 Resistor
	13 Capacitor	20 Capacitor	28 Panel

Figure 4-3. Circuit Board Assembly

h. A lead assembly (25), two capacitor assemblies (26) and four brush holders (35) may be removed from the DC shield (36). Two springs (32) are removed from each brush spring pin (33), loosen a set screw (34).

i. Remove the bearing plate (39), shim washer (41), loading spring (42) and shim washers (43) from the AC end shield assembly (49).

j. Remove the cover plate (44) from the AC end shield assembly (49). Remove two screws (46) to free the stator leads from the AC end shield.

k. Remove the AC end shield assembly (49) from the stator (67). Tap the end shield several times with a fiber mallet to facilitate removal.

l. Remove from the AC end shield assembly (64), a resistor assembly (50), two capacitor assemblies (53), an air duct (57) and two lead assemblies (60).

m. Remove the armature (66) from the DC end of the stator (67). Press ball bearings (37 and 65) from the shaft of armature (66). Remove an internal bearing plate (38) from the armature shaft.

CAUTION

Do not disassemble the armature assembly (66) or stator assembly (67) beyond the point indicated in the exploded view. Handle the armature carefully. Provide suitable protection for commutator, slip rings and bearing journal surfaces.

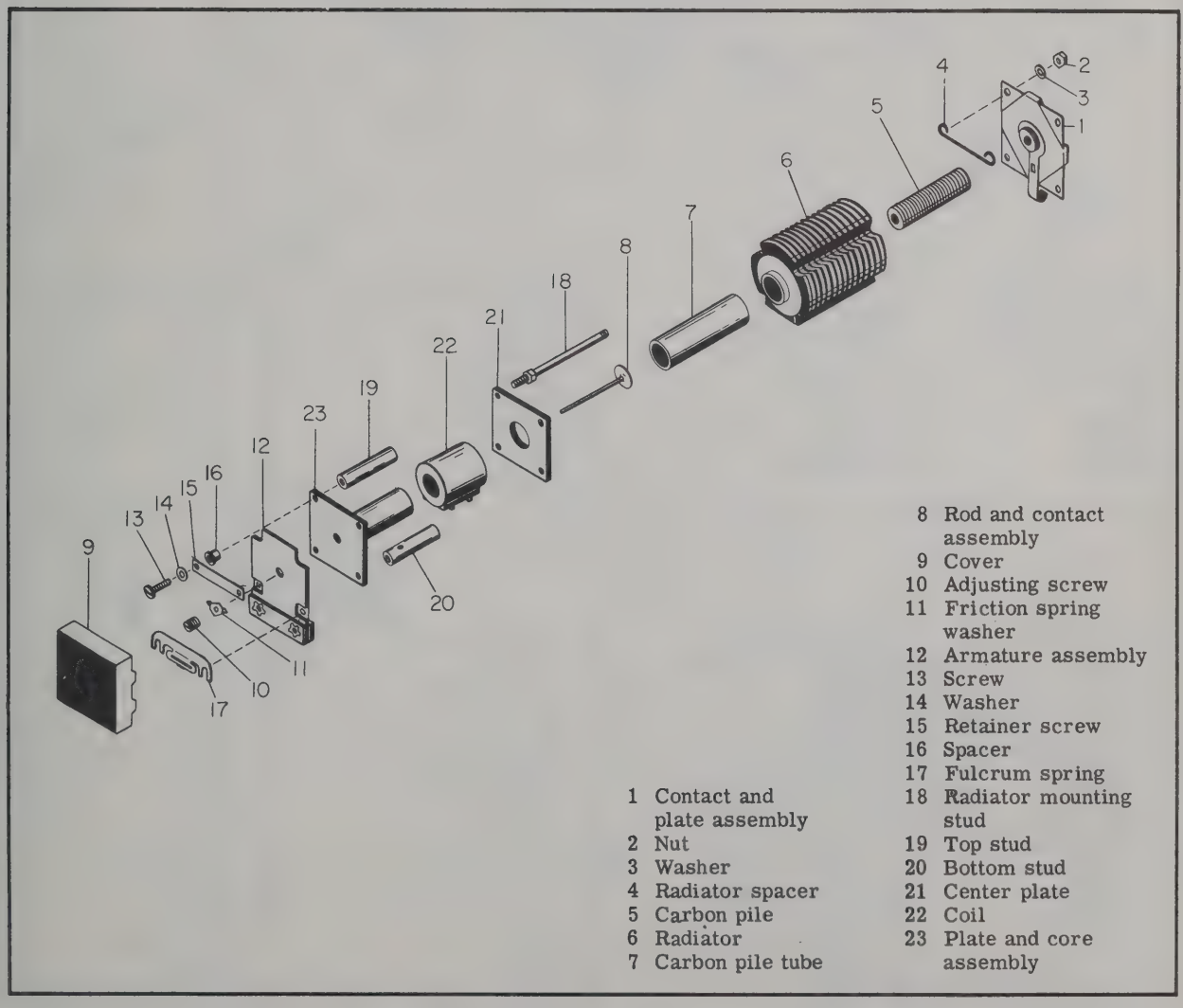
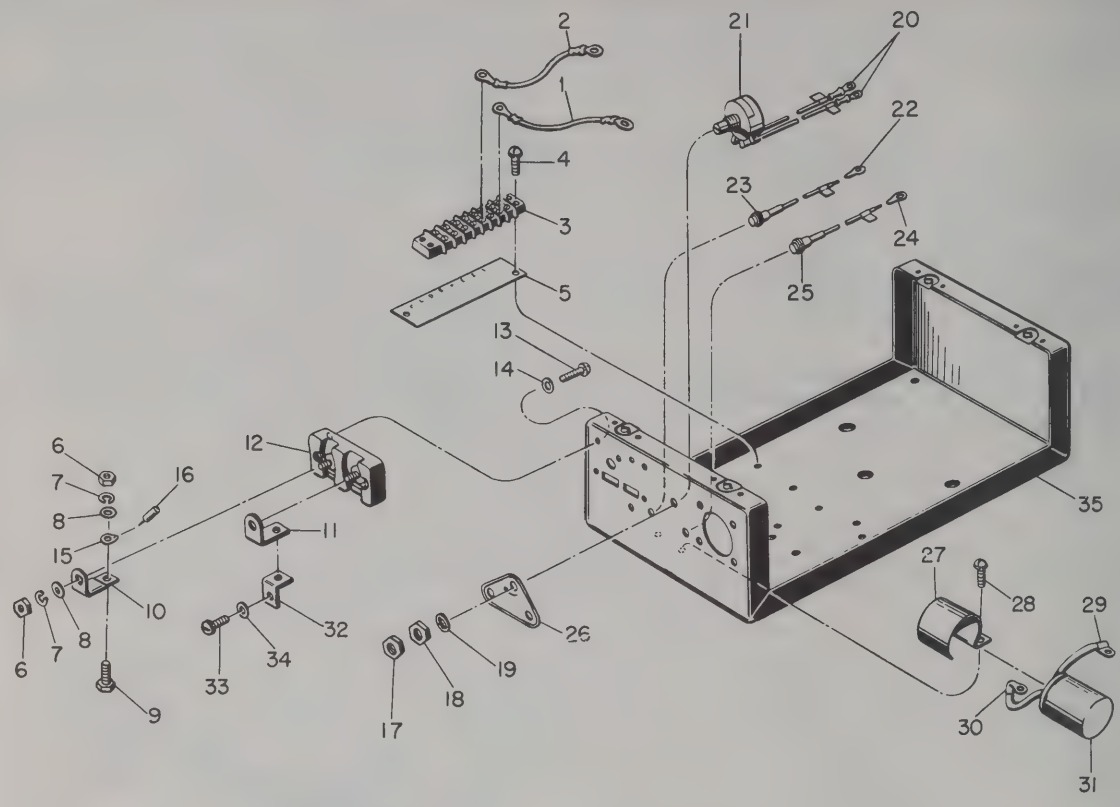


Figure 4-4. Amplifier Assembly



1 Lead assembly
2 Lead assembly
3 Terminal board
4 Screw
5 Marker strip
6 Nut
7 Washer
8 Washer
9 Screw
10 Terminal strap assembly
11 Terminal strap
12 Terminal board assembly
13 Screw
14 Washer
15 Terminal
16 Capacitor
17 Shaft locking nut
18 Nut
19 Washer
20 Terminal
21 Rheostat
22 Terminal
23 Connector (black)
24 Terminal
25 Connector (red)
26 Instruction plate
27 Capacitor clamp
28 Screw
29 Terminal
30 Terminal
31 Capacitor assembly
32 Bracket assembly
33 Screw
34 Washer
35 Housing assembly

Figure 4-5. Housing Unit

Legend for Figure 4-6.

1 Fan cover
2 Screw
3 Washer
4 DC brush
5 Screw
6 AC end cover
7 Screw
8 Washer
9 Brush holder cap
10 Straight brush assembly
11 Angle brush assembly
12 Lock nut
13 Lock washer
14 Electrical rotating equipment fan
15 Flat key
16 Fan spacer
17 External bearing plate
18 Screw
19 Washer
20 Screw
21 DC end bell unit
22 Thru bolt screw
23 Nut
24 Screw
25 Lead assembly
26 Capacitor assembly
27 Screw
28 Capacitor clip
29 Screw
30 Washer
31 Bushing
32 Spring
33 Brush spring pin
34 Set screw
35 Brush holder
36 DC shield
37 Ball bearing
38 Internal bearing plate
39 Bearing plate
40 Screw
41 Shim washer
42 Loading spring
43 Shim washer
44 AC end cover plate
45 Screw
46 Screw
47 Washer
48 Washer
49 AC end shield
50 Resistor assembly
51 Screw
52 Washer
53 Capacitor assembly
54 Screw
55 Washer
56 Capacitor clamp
57 Air duct
58 Screw
59 Washer
60 Lead assembly
61 Screw
62 Washer
63 Washer
64 AC end shield assembly
65 Ball bearing
66 Armature assembly
67 Stator

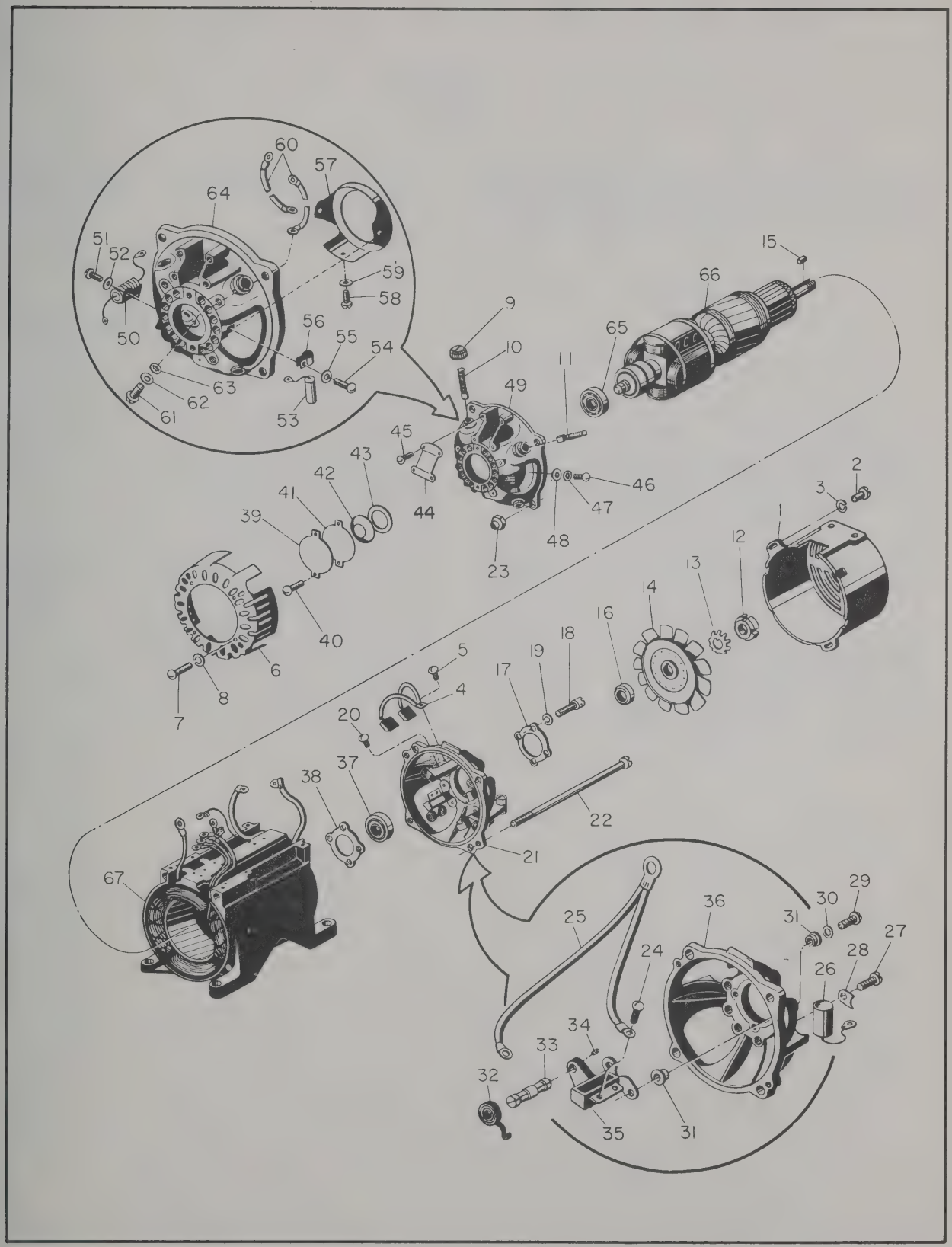


Figure 4-6. Motor-Generator Assembly

SECTION V

CLEANING

5-1. GENERAL. Cleaning of the component parts of the control should be confined to the procedures outlined in figure 5-1.

CAUTION

Avoid soaking any of the electrical components in cleaning solvents.

5-2. ARMATURE AND STATOR. Wipe these assemblies with cleaning solvent, Federal Specification P-S-661 and clean thoroughly with a brush. After cleaning, dry out the armature and stator assemblies by baking for 2 to 4 hours at 93°C (200°F).

CAUTION

Do not soak these assemblies in cleaning solvent.

Component	Cleaning Procedure
Circuit board assembly	Use compressed air not over 30 PSI and a dry soft-bristled brush to remove dust and dirt from electrical components. Use a clean cloth to wipe off electrical components.
Carbon pile amplifier assembly	Clean the carbon pile tube, radiator and any other all metal parts of the carbon piles in cleaning solvent, Federal Specification P-S-661. Dry with compressed air. Clean other parts with a soft-bristled brush and compressed air. Carbon pile tube should be scrubbed inside using a soft-bristled cleaning brush.
Terminals and terminal lugs	Clean all terminals and terminal lugs with a cloth dampened in cleaning solvent, Federal Specification P-S-661 until the metal is bright.
Rheostats, transformer and reactor	Clean with compressed air and a soft-bristled brush. Remove any excess dirt with a cloth.
Container, friction plates	Clean these parts by wiping with a cloth dampened with solvent, Federal Specification P-S-661. Wipe dry with a clean lint free cloth or use compressed air.

Figure 5-1. Cleaning

SECTION VI

INSPECTION

6-1. GENERAL.

6-2. Carefully inspect all plastic and metal parts for wear or damage. Replace damaged wiring in accordance with the wiring schematic diagrams, figures 7-1 and 7-2. Check terminal connections. Refer to figure 6-1 for inspection procedures.

NOTE

After each part has been cleaned it should be placed in a dust free container for inspection at a later date.

Nomenclature	Figure & Index NO.	Procedure
MOTOR-GENERATOR COMPONENTS		
Stator assembly	fig. 4-6, index NO. 67	DC STATOR. Using a high potential tester, apply 220 volts at a commercial frequency between the machined dowel and one of the two shunt leads (light) and between the dowel and one of the two series leads (heavy). Then apply the voltage between one of the series leads to check for shorts between the windings. **WARNING** Precautions should be taken to avoid accidental contact with conductors carrying high voltage. The resistance of the shunt winding (light) should be 3.2 ± 10 percent ohms as measured between the two light leads. The series winding (heavy) should show very low resistance, less than 0.03 ohms as measured between the heavy leads. AC STATOR. Apply 500 volts at a commercial frequency between the machine dowel and each of the stator leads. The resistance of each of the AC stator windings should be 0.105 ± 10 percent ohms.
Armature assembly	fig. 4-6, index NO. 66	Make a careful inspection of the armature to detect wear and any obvious damage. The armature measurements must conform to those given in figure 6-2. Using a high potential tester, apply 220 volts at commercial frequency between any of the commutator bars and the armature shaft. When touching a bar, stay outside the brush path to avoid pitting the brush track. Also apply 220 volts between the armature shaft and each of the two collector rings. Always touch the test prod to the sides of the collector rings in order that the brush tracks may not be damaged. **WARNING** Take precautions to avoid accidental contact with conductor carrying high voltage.

Figure 6-1. Inspection

SECTION VI

INSPECTION

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Armature assembly	fig. 4-6, index NO. 66	Make a careful inspection of the armature to detect wear and any obvious damage. The armature measurements must conform to those given in figure 6-2. Using a high potential tester, apply 220 volts at commercial frequency between any of the commutator bars and the armature shaft. When touching a bar, stay outside the brush path to avoid pitting the brush track. Also apply 220 volts between the armature shaft and each of the two collector rings. Always touch the test prod to the sides of the collector rings in order that the brush tracks may not be damaged. **WARNING** Take precautions to avoid accidental contact with conductor carrying high voltage.

Figure 6-1. Inspection

Nomenclature	Figure & Index NO.	Procedure
MOTOR-GENERATOR COMPONENTS (Continued)		
Armature assembly (Continued)	fig. 4-6, index NO. 66	Check the resistance between the collector rings. It should be 3.15 ± 10 percent ohms. Check commutator bars for alignment and tightness. If any high bars are found, replace the complete armature assembly. If bars are badly burned, replace the armature as this is an indication of open-circuited armature coils. Balancing. Dynamic unbalance will be detected by rough or noisy rotation. Normally an armature assembly will not lose its balance unless it has been bent or severely damaged. If the armature does require rebalancing refer to paragraph 7-1.
AC shield assembly	fig. 4-6, index NO. 64	Check brush holders. They must be clean. Brushes must slide freely in holders. The bearing housing must be smooth and free of scoring marks.
DC shield	fig. 4-6, index NO. 36	Inspect bearing housing. It must be smooth and free of scoring marks.
Brush holders	fig. 4-6, index NO. 35	Brushes must slide freely in brush boxes. Boxes must be clean. Spring (33) tension should be 20 ± 10% OZ at a position 30 degrees above new brush position.
DC brushes	fig. 4-6, index NO. 4	Replace motor brushes when worn down to less than 9/16 inch (or reference wear groove).
AC brushes	fig. 4-6, index NOS. 10 and 11	Replace exciter brushes when worn down to less than 7/16 inch (or reference wear groove).
CONTROL BOX BASE ASSEMBLY		
Terminal boards	fig. 4-5, index NOS. 3 and 12	Visually inspect for cracked or broken terminal barriers.
Rheostat	fig. 4-5, index NO. 21	Inspect rheostat for physical damage, burns or excessive wear. The rheostat resistance should be 5 ohms, ± 10 percent ohms.
Capacitors	all	Check for grounded or shorted capacitor.
Undervoltage relay	fig. 4-1, index NO. 21	Visually inspect for damaged terminals and other signs of physical damage. Pull-in voltage of the relay (21) should be 50 volts AC, +10, -5 volts, 400 CPS; drop out voltage should be 35 volts AC, +3, -5 volts, 400 CPS.
Resistors	all	Visually inspect for burned or cracked resistors. Inspect for damage or leakage.
Relay assembly	fig. 4-1, index NO. 20	Visually inspect for damaged terminals and other signs of physical damage. Resistance of coil should be 45 ohms ± 5 percent. Connect relay to DC power source. Pull-in voltage should be 18 volts or less.
AMPLIFIER ASSEMBLIES		
Rod and contact assembly	fig. 4-4, index NO. 8	Rod must be straight and contact perpendicular to rod.
Fulcrum springs	fig. 4-4, index NO. 17	Fulcrum spring must not be deformed. Compare with spring of correct contour.

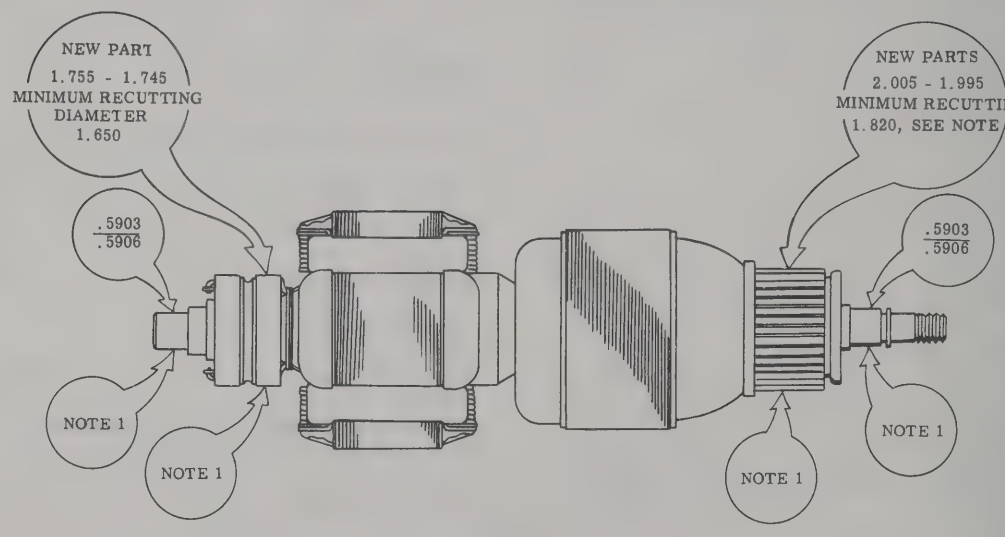
Figure 6-1. Inspection (Continued)

Nomenclature	Figure & Index NO.	Procedure
AMPLIFIER ASSEMBLIES (Continued)		
Coil (voltage)	fig. 4-4, index NO. 22	Coil resistance should be 10,300 ohms ± 10 percent between the white and blue leads; 380 ohms ± 5 percent between the red and yellow leads. Assemble coil to core. Test for grounded windings or shorted coils by touching prods of a high resistance ohmmeter to coil leads and core and between white and red leads. If reading is less than 500,000 ohms, replace coil assembly.
Coil (frequency)	fig. 4-4, index NO. 22	Coil resistance should be 11,500 ohms ± 10 percent between white and blue leads; 115 ohms ± 10 percent between red and yellow leads. Assemble coil to core. Test for grounded windings or shorted coils by touching prods of high resistance ohmmeter to coil leads and core and between white and red leads. If reading is less than 500,000 ohms, replace coil assembly.
Adjusting screw	fig. 4-4, index NO. 10	Check fit. If screw binds, run soft lead pencil over threads.
Armature assembly	fig. 4-4, index NO. 12	Must be absolutely flat.
VOLTAGE AND FREQUENCY CONTROL ASSEMBLY		
Transformer	fig. 4-3, index NO. 7	Inspect for damage. Check per following procedure: 1. Apply 115 VAC (±1/2V), 400 CPS between primary (Black-White) leads. 2. Output voltages should read: White - Red 151 ± 3 V White - Blue 39 ± 2 V White - Green 83 ± 3 V White - Yellow 150 ± 3 V Purple - Purple 4.5 ± 0.3 V 3. Primary magnetizing current - 14 MA MAX. Voltmeter used must be 5000 ohms-volt or more.
Reactor assembly	fig. 4-3, index NO. 5	Inspect and check resistance, 1650 ohms ± 10 percent.
Rheostat	fig. 4-3, index NO. 3	Inspect rheostat for physical damage, cracks, burns, or excessive wear. The resistance should be 3,000 ohms, ± 10 percent.
Tubes	fig. 4-3, index NOS. 10, 11 and 12	Refer to the wiring diagram, figure 7-2. Location of tubes are as follows: Looking at the tube side of the circuit board assembly, with the tubes at the top position, the tubes reading from left to right are identified as V2, V1, V3, V5 and V4. NOTE Tube checking can only be done while control assembly is connected to either an inverter or in the manner listed below.

Figure 6-1. Inspection (Continued)

Nomenclature	Figure & Index NO.	Procedure
VOLTAGE AND FREQUENCY CONTROL ASSEMBLY (Continued)		
Tubes (Continued)	fig. 4-3, index NOS. 10, 11 and 12	Apply 28 volts DC to terminal "2" and terminal "GR" of the regulator assembly. Observe the tube filaments. Tubes V1, V2, V3 and V4 should light up. Any open filament will prevent all of the tubes from lighting. To determine a defective tube, check each tube V1, V2, V3 and V4 with an ohmmeter across pins 3 and 6. Replace any defective tubes in accordance with paragraph 7-4. Apply 115 volts, 400 cycle AC to terminal "4" and 29 volts DC to terminal "2" grounding terminal "GR"; short terminals "7" and "8" with a 5 ohm, 5 watt resistor. Tube V3 should light. If tube V3 flickers or does not light, replace it in accordance with paragraph 7-4. Also check pins NO. 7 of tubes V2 and V4. They should indicate a reading of +185 to 200 volts. Check pins NO. 1 of tubes V2 and V4. They should indicate a reading of -185 to -200 volts.

Figure 6-1. Inspection (Continued)



NOTE 1. DIAMETERS MUST BE CONCENTRIC WITHIN .001 INCH TOTAL INDICATOR READING.

NOTE 2. COMMUTATOR MUST BE SMOOTH AFTER RECUTTING AND MICA MUST BE UNDERCUT SO THAT SIDES OF BARS ARE FREE OF MICA AT LEAST .010 INCH BELOW BRUSH AND .030 INCH EACH SIDE OF BRUSH TRACK. WIRE EDGES AND BURRS MUST BE REMOVED FROM BARS.

Figure 6-2. Armature Wear Inspection Dimensions

SECTION VII

REPAIR AND REPLACEMENT

7-1. ARMATURE REPAIR.

a. Use a dynamic balancing machine and additive balancing on the commutator balance plate and on the AC exciter slot wedges to rebalance the armature. If the commutator contact surface is rough or in such condition that it cannot be restored by cleaning, the commutator should be turned down as follows: Mount the armature assembly in a lathe between centers. Inspect the concentricity of the armature by placing a dial indicator against the journal and turning the armature by hand. With a sharp lathe tool (diamond cutting tool) take a light cut not to exceed 0.0005 inch across the commutator surface. Take a second cut, if necessary, to remove rough spots or grooves. Remove all copper burrs.

b. Undercut mica between bars; use a 1/2-inch diameter "V" slot cutter to produce a "V" of approximately 50° included angle. Cut to a depth so that approximately 0.025 inch of bare copper is exposed from surface of commutator to mica. 1-1/16 inch from outward edge of commutator toward commutator riser should be full depth of undercut. Make certain that no mica clings to the sides of slot. Polish the commutator with NO. 0000 sandpaper, being careful not to scratch the surface. Do not use emery or carborundum cloth. Chamfer the edges of each bar with very fine sandpaper on a straight edge or fine stone. Make certain the commutator is absolutely smooth after this operation. Blow out all dust when finished. Recheck the concentricity. It must be within 0.001 inch, total indicator reading.

c. Polish the collector rings with NO. 0000 sandpaper. If the contact surface is rough, scored or in such condition that it cannot be restored by cleaning, turn the collector rings down in the same manner as the commutator bars.

d. Clean and bake the armature assembly in accordance with paragraph 5-2.

e. Repeat the electrical checks as outlined in paragraph 6-1.

7-2. BRUSH SPRINGS.

7-3. Springs (fig. 4-6, ref. 32) tension should be 20 ounces $\pm$ 10 percent at a position 30 degrees above new brush positions.

7-4. REPAIRING PRINTED CIRCUIT.

7-5. Replace tubes and components in accordance with the following.

a. Solder joints shall be neat and smooth, without pinholes, peaks or sharp protrusions. The solder surface shall be bright, glossy and flux-free. Use materials only as specified below, or, approved equivalents. Do not use excessive amounts of solder. Do not use touch-up enamel on internal mechanisms and external slide mating surfaces of mating parts.

b. The following materials are to be used when replacing a part: Flux cored solder of 0.043-inch diameter or liquid flux may be used in place of the cored solder; Isopropyl alcohol; clear insulating touch-up enamel; solvent (for touch-up enamel).

c. After locating defective component(s), carefully remove the part(s) without disturbing the adjacent components or their protective coatings. When defective component(s) incorporate(s) common solder junctions with other components, do not disturb the common joints unless the terminal leads of the defective part cannot be used as splice stubs for replacement part. Upon removal of desired parts, take the following steps in exact sequence to install the replacement part.

d. Thoroughly clean all disturbed terminations by abrading or scraping the protective coating from the intended connection surfaces.

e. Wipe the terminal surfaces with a clean cloth dampened with alcohol.

f. Insert replacement part in identical location and disposition as previous part, or in specified new location. Resultant lead lengths and required insulation should closely approximate the amounts and types used on the original installation.

g. Complete splices by mechanical methods (hook, twist, insertion, etc.) and replace any component supports. Solder junctions using materials specified. Use conductive transfer heating methods, only, in the replacement of parts, i.e. irons, guns, pencils, etc. Do not apply direct flame to any of the components.

CAUTION

The maximum temperature resistance of the majority of the components involved range to 250° F (121° C). Exercise care that soldering operations at terminations do not result in excessive thermal transfer through leads or supporting members.

h. Wash flux residues from solder joints with alcohol and recoat all disturbed components and junctions with insulating enamel by brush application of a mixture of three parts enamel to two parts solvent.

B1 - Motor
C1 - 0.1 UF, 100 VDC
C2 - 10.0 UF, 150 VDC
C3, C4 - 1.0 UF, 200 VDC
C5, C6 - 0.01 UF, 100 VDC
FL1 - Noise filter
G1 - Exciter
J1 - Jack (G), J2 - Jack (A)
J3 - Connector MS3102-24-2S
K1 - Relay, starting
K2 - Relay, undervoltage
L1, L3 - Coil, series field
L2, L4 - Coil, compound field
L5 - Coil, shunt field
L6, L7, L8 - Coil, AC field
L9 - Coil, relay
L10 - Choke
R1 - 35 ohms, 25 watts
R2 - 5 ohms, 2 watts
R3 - 390 ohms, 3 watts
TB1 - Terminal board, input
TB2 - Terminal board

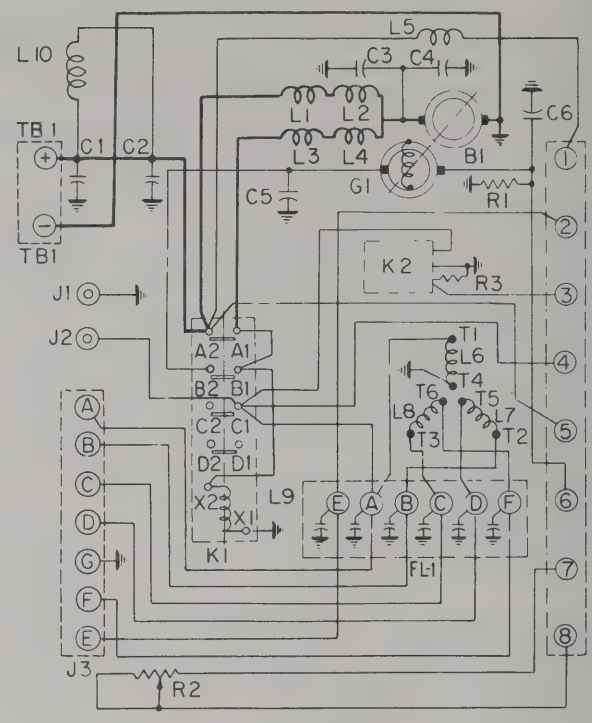


Figure 7-1. Unit Schematic Wiring Diagram

C1, C5 - 0.0047 UF, 300 VDC
C2 - 0.22 UF, 100 VDC
C3, C7 - 0.00068 UF, 300 VDC
C4 - 0.22 UF, 300 VDC
C6 - 0.033 UF, 200 VDC
L1 - Voltage coil
L2 - Voltage coil
L3 - Frequency coil
L4 - Frequency coil
R1 - 0.39 megohm, 1/4 watt
R2, R3 - 1.5 megohm, 1/2 watt
R4, R11 - 0.39 megohm, 1/2 watt
R5 - 180 ohms, 3 watts
R6 - 8.2 ohms, 5 watts
R8 - Frequency carbon pile
R9 - Voltage carbon pile
R10 - 1.5 megohms, 1/2 watt
R12 - 33,000 ohms, 1/2 watt
R13 - 330 ohms, 1/2 watt
R14 - 330 ohms, N.T.C., 1/2 watt
R15 - 3000 ohms, 1.5 watts
R16 - 0.22 megohms, 1/2 watt
R17 - 2.2 megohms, 1/2 watt
R18 - 0.39 megohms, 1/2 watt
R19 - 1.0 megohms, 1/2 watt
T1 - Transformer
V1, V2, V4 - Tube 5896
V3 - Tube 6021
V5 - Tube 6352
Z1 - Tuned Circuit

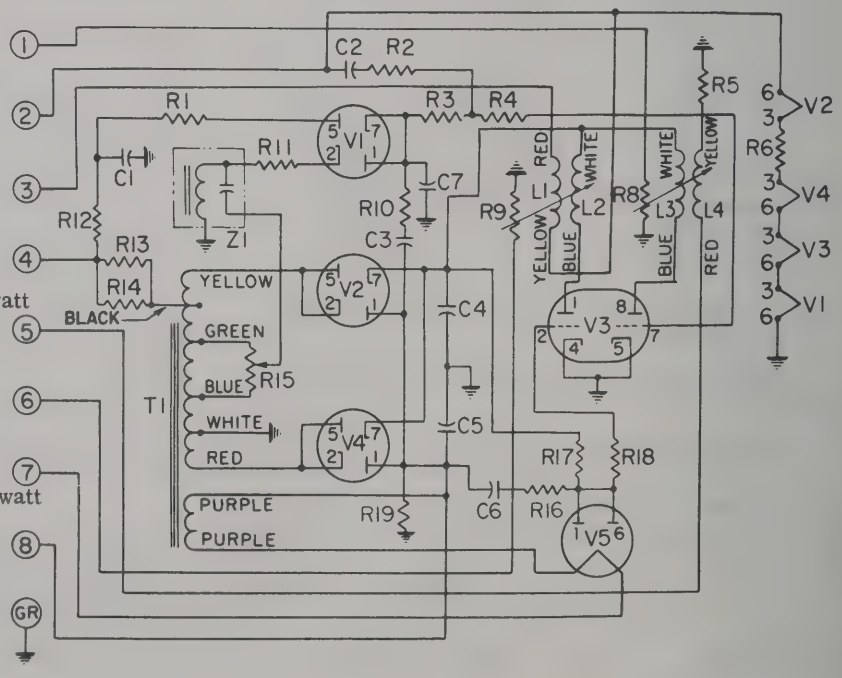


Figure 7-2. Control Schematic Wiring Diagram

NOTE

This treatment should result in the application of a continuous smooth, encompassing film which has reblended into the original coating at all contact surfaces between the supporting plate and components. Successive applications may be required to obtain a satisfactory protective film of between two and three mils. Care must be exercised to exclude airborne dust, fumes, or dirt from the area during the touch-up or drying periods. Brushes must be clean and pliable.

i. Dry the touch-up enamel as follows: Between coats, air dry two hours or bake 1/2 hour at 190°F (88°C). Final coat; air dry four hours or bake one hour at 190°F (88°C).

7-6. BRUSH RUN-IN.

a. Connect the inverter to a power source and load bank. Adjust DC input to 27.5 volts.

b. Set the voltage adjustment rheostat and frequency adjustment rheostat at midpoint.

c. Start inverter. Allow approximately 10 seconds for tubes to warm up if power was not previously connected to input terminals.

d. Set the voltage adjustment rheostat so inverter output is 400 CPS.

e. The face of each commutator brush shall contact its commutator 100 percent in the direction of rotation for at least 75 percent of brush dimension parallel to the shaft. The face of each slipring brush shall contact its slipring over an area that will insure satisfactory performance of the inverter; however, as a minimum requirement, slipring brush contact area shall be 50 percent.

7-7. SETTING BRUSH NEUTRAL. (See figures 7-3 and 7-4.)

NOTE

Neutral must only be set when either the armature, DC shield assembly or stator are changed. On nameplate side of motor-generator there is a neutral setting index mark across the edge of DC end shield and stator, painted orange. For minor overhauls, it may not be necessary to reset neutral.

a. DC end shield position must be set with respect to armature and stator so as to locate brushes at electrical neutral. The procedure is as follows.

NOTE

Remove DC brushes for neutral setting.

b. Connect a DC millivoltmeter (0-50 millivolts) such as used to measure DC amperes in conjunction with an external shunt to a pair of insulated test probes. (See figure 7-3.)

c. Rotate armature until center of a commutator bar lines up with center of a brush assembly holder slot as closely as possibly. Check adjoining brush assembly holder; it should have a bar centered in its slot.

d. While holding the armature to prevent rotating, carefully hold test probes on central bars in adjoining brush holders while an assistant touches approximately 24 volts DC to open shunt field leads for just one second. The millivoltmeter pointer should suddenly deflect slightly and return. (See figure 7-4.)

e. Maintaining same polarities on meter and 24-volt connections throughout adjustment, loosen thru bolts and rotate DC end shield about 1/64 inch at a time and repeat steps c and d each time, until meter shows no deflection when the voltage is applied to shunt field. Tighten thru bolts.

CAUTION

Dummy brushes should be used instead of test probes. This will insure more positive armature location. Dummy brushes should be constructed in accordance with figure 7-5.

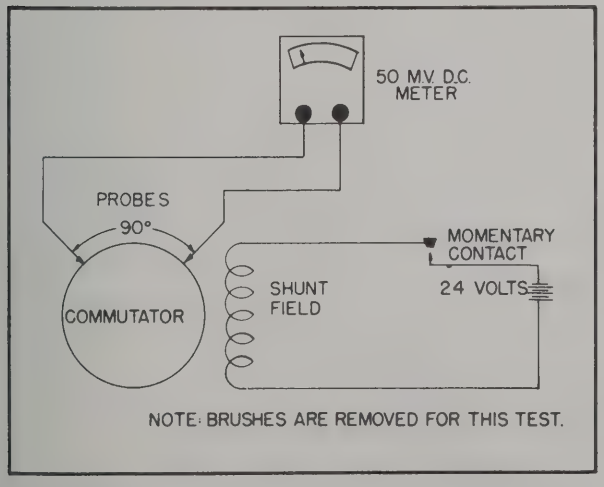


Figure 7-3. Neutral Setting Wiring Diagram

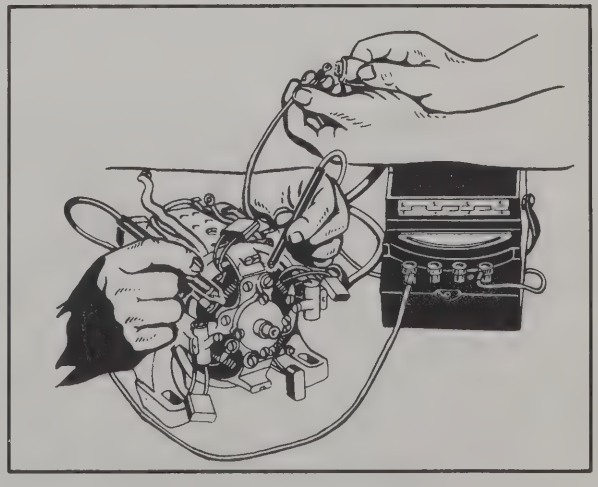


Figure 7-4. Neutral Setting

f. Replace DC brushes in brush assembly holders of DC shield assembly.

NOTE

Make certain that brushes slide easily without binding and brush tension springs engage brushes at center point between leads.

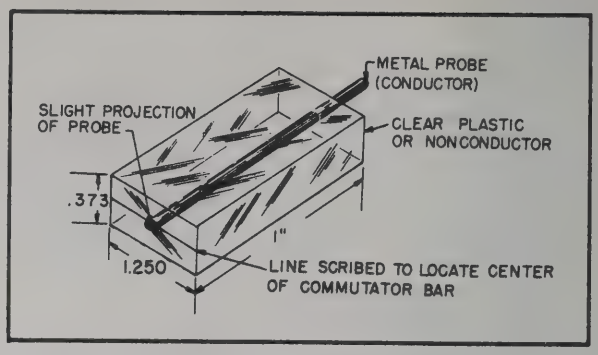


Figure 7-5. Dummy Brush

SECTION VIII

ASSEMBLY AND TESTING OF ASSEMBLIES AND SUBASSEMBLIES

8-1. This section is not applicable.

SECTION IX

REASSEMBLY AND TESTING OF COMPONENTS

9-1. MOTOR-GENERATOR. (See figure 4-6.)

a. Assemble the resistor assembly (50) to the AC end shield assembly (64). Slide a capacitor (53) into each of two capacitor clamps (56) and secure in the end shield. Refer to figure 9-1, and make up the terminal and lead connections as indicated. Assemble the air duct (fig. 4-6, ref. 57) to the AC end shield assembly (64).

b. Center a brush spring pin (33) in each brush holder (35). Slide two springs (32) on each pin. Set screw (34) is tightened after brush spring tension is adjusted.

c. Assemble four brush holder assemblies to the DC shield (36). Two bushings (31) are used at each mounting hole of the two insulated brush holder assemblies as indicated in figure 9-2. Secure all capacitor assemblies (fig. 4-6, ref. 26) to the DC shield (36) with a capacitor clip (28) and at each location. Refer to figure 9-2 for proper location of capacitor terminals as well as wiring of the end shield.

CAUTION

Make sure the internal bearing plate (fig. 4-6, ref. 38) is in position at the DC end of the armature before assembling ball bearings.

d. Press new ball bearings (37 and 65) on both ends of the shaft of armature assembly (66). Apply pressure to inner race of ball bearing until it is seated against the shoulder on both ends of the shaft.

CAUTION

Use only new bearings at reassembly as bearings are of the permanently lubricated type. Other than the ball bearings, the unit does not require lubrication.

e. Work the AC end shield subassembly (64) over the shaft of the armature and onto the stator (67). Tap the shield lightly with a fiber mallet to seat.

f. Install the armature assembly (66) in the stator (67) from the AC end. Work the DC end shield in position over the bearing (37) and onto the stator (67). Tap the end shield with a fiber mallet to fully seat it. Position the external bearing plate (17) over armature shaft and the DC shield (36). Install four screws (18) with lock washers (19) through the bearing plate (17) end shield (36) and into the internal bearing plate (38). Tighten and lock wire the screws (18).

g. Install thru-bolt screws (22) and nuts (23) at AC end of unit. Torque thru bolts evenly 40 to 50 IN. LB at room temperature.

h. Place loading spring (42) on the AC end of the armature shaft and measure the "A" distance as indicated in figure 9-3. Add 0.010 to 0.015 inch to the "A" reading to obtain the required shim thickness. Remove the loading spring (fig. 4-6, ref. 42) and add shim washers; replace loading spring. Position shim washers (41) and bearing plate (39) and fasten in place with two screws (40).

i. Check that the armature rotates freely when turned by hand.

j. Short-circuit test the armature assembly as outlined in figure 6-1.

k. Setting of neutral, if required, should be performed as outlined in paragraph 7-7.

l. Install DC brushes by lifting brush tension springs and installing four new DC brush assemblies (4) in the brush holder assemblies. The face of the brushes must fit the contour of the commutator. Attach each set of brush leads to its brush holder with a screw (5).

m. Install two new straight AC brushes (10) and angle brush assembly (11) in the AC end shield. Assemble a brush holder cap (9) at each brush holder. To the DC end of the armature shaft, assemble in order, a fan spacer (16), flat key (15), fan (14), new lock washer (13) and a lock nut (12). Bend the tabs of lock washer (13) to lock the nut (12).

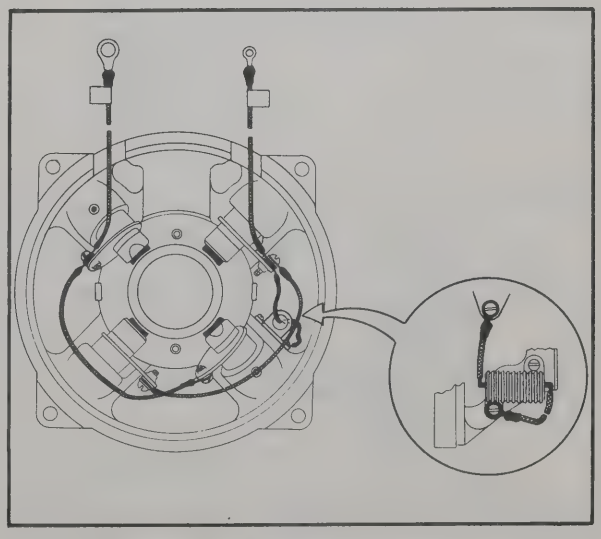


Figure 9-1. AC Shield Assembly

9-2. CONTROL BOX BASE. (See figure 4-5.)

a. Position the capacitor (31) in the control box base assembly (35) and secure with a capacitor clamp (27) and two screws (28).

b. Position the instruction plate (26) on the outside of the control box base and assemble the two connectors (23 and 25) with the hardware provided.

c. Work the shaft of the rheostat (21) through the opening in the control box base and instruction plate (26). Secure the rheostat with washer (19) and nuts (17 and 18).

d. Assemble capacitor (16) in the clip provided at the end of the control box base with the terminal (15) end down.

e. Position the terminal board assembly (12) on the end of the control box base and secure at the inside with four screws (13) and washers (14). Assemble terminal straps (10 and 11) in the terminal board (12) over the studs. Secure the straps with hardware (6, 7 and 8).

f. Secure terminal (15) to strap (10) with hardware (6, 7, 8 and 9).

g. Assemble the bracket assembly (32) to the end of the control box base with a screw (33) and washer (34). Note that the bracket (32) is located under the terminal strap (11).

9-3. ASSEMBLING CONTROL BOX BASE TO THE MOTOR-GENERATOR. (See figure 4-1.)

a. Position the control box base assembly (45) over the motor-generator (53) and work the leads up through the openings in the control box. Secure the control box assembly to the motor-generator with three screws (46 and 47), a terminal stud (37) and washers (35 and 36). The ground lead from the terminal board stud is positioned under the stud (37). Install two relays (20 and 21) and a radio noise filter (27) in the control box.

NOTE

Assemble leads to relay (20) before installing relay in control box base assembly.

b. Make up the wiring connections using lead assemblies (fig. 4-5, ref. 1 and 2) in accordance with the wiring diagram, figure 7-1.

9-4. AMPLIFIER ASSEMBLY. (See figure 4-4.)

a. Place a small amount of varnish, Schenectady ST 6, or equivalent, on the core and plate assembly (23). Allow the varnish to become tacky.

b. Install the coil assembly (22) on the plate and core assembly (23). On both amplifiers, the blue (P) terminal must be closest to the plate and core assembly (23). The terminals should be perpendicular to one side of the core and plate assembly.

c. Install center plate (21) on core and plate assembly. Make certain center plate fits square and the mounting holes align with the holes in plate and core assembly. The finished side of the center plate must be outward.

d. Place assembled unit on a flat surface with the plate and core assembly forward. Terminals must be positioned as shown in figure 9-4 for the voltage amplifier and figure 9-5 for the frequency amplifier.

e. Install the studs (19 and 20, figure 4-4) as shown in figures 9-4 and 9-5.

f. Install four radiator mounting studs (18, figure 4-4).

g. Position armature assembly (12) on plate and core assembly (23) so that counterweight end is positioned as

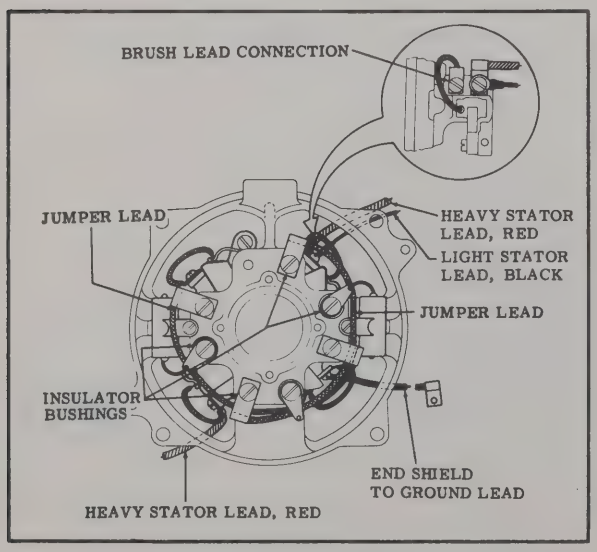


Figure 9-2. DC End Shield Assembly

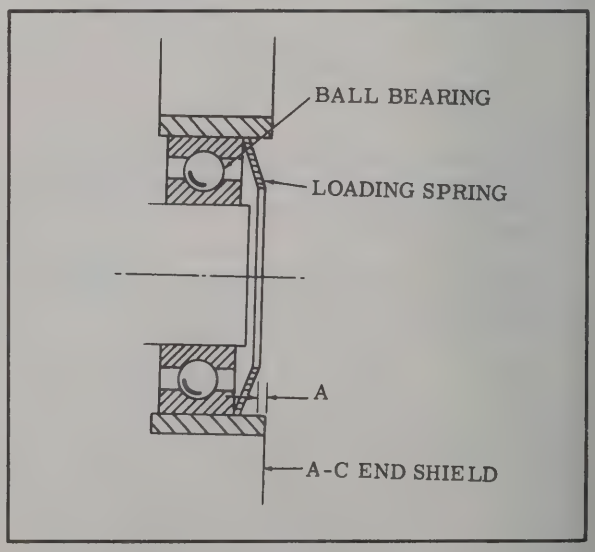


Figure 9-3. Measuring Load Spring Deflection

shown in figure 9-4 for voltage amplifier and figure 9-5 for frequency amplifier. Attach with two collar spacers (16), fulcrum spring (17) and two screws (13) at counterweight end.

h. Stand assembly up so that it rests on armature assembly. Install rod and contact assembly (8) in opening in center of core and plate assembly (23).

i. Install the carbon pile tube (7) in the radiator (6) and position the carbon pile tube on the center plate (21) so that it is supported by the end of the core of the core and plate assembly (23). Place on the two top studs (18) protruding beyond the radiator (6), the radiator spacer (4) so that straight side of radiator spacer (4) is toward the carbon pile tube (7). Radiator spacer prevents radiator from shorting out on contact plate.

j. Without touching with the fingers slide a new carbon pile (5) out of its glass container and onto a clean, smooth 1/8-inch rod or equivalent tool. Gently shake the rod to separate the pile discs and inspect for broken discs. Insert the rod into the carbon pile tube (7) until the rod touches the contact on the end of the rod and contact assembly (8). Tip the unit and the rod to allow the discs to slide into the carbon pile tube. Withdraw the rod and gently tap the assembly to insure that all discs are level.

CAUTION

If there is evidence that the carbon pile or container has been tampered with, discs added or removed, use a new carbon pile.

k. Assemble the contact and plate assembly (1) to the radiator studs (18) using four nuts (2) and lock washers (3). The contact protruding from the contact and plate assembly must be toward the same side as the armature counterweight (12). Refer to figure 9-4 or 9-5.

l. Install adjusting screw (10, figure 4-4) with sheet spring nut (11) in the hole in center of armature assembly (12).

9-5. ADJUSTING AMPLIFIERS. (See figure 4-4.)

9-6. VOLTAGE AMPLIFIER.

a. Insert a piece of non-magnetic shim material 0.004 inch thick, between the top of the armature assembly (12) and the plate and core assembly (23).

b. Connect 150 volts DC to the blue and white lead. Connect an ohmmeter, capable of reading accurately from 0-10 ohms and 0-300 ohms, between the amplifier frame and the contact and plate assembly.

c. To set minimum resistance apply the voltage and turn the adjusting screw (10) until a 1-1/2 ohm reading is obtained. Cut and apply voltage three or four times to check that the reading holds consistently.

d. To set maximum resistance remove the shim and disconnect the power source. Loosen the two screws (13) attaching the fulcrum spring (17). Slide the fulcrum spring up and down until a reading of from 160 to 200 ohms is obtained. Tighten the screws (13) when this reading is obtained. After setting, energize coil three or four times and check that the reading is constant.

9-7. FREQUENCY AMPLIFIER. The frequency carbon pile amplifier is adjusted in the same manner as described for voltage carbon pile amplifier in paragraph 9-6, except that the ohm reading when adjusting minimum resistance is 3 ohms. When adjusting maximum resistance the fulcrum spring must be set to obtain a reading of 200 to 300 ohms.

9-8. COMPLETING AMPLIFIER ASSEMBLY. (See figure 4-4.) After making the necessary adjustments, snap the cover (9) into position over the armature (12).

9-9. REASSEMBLY OF CIRCUIT BOARD ASSEMBLY. (See figure 4-3.)

a. Assemble the rheostat (3) to the rheostat mounting bracket (4) with the reactor assembly (5) and transformer (7) to the circuit board subassembly (28) by using two screws (6 and 8).

9-10. REASSEMBLY OF VOLTAGE AND FREQUENCY CONTROL. (See figure 4-2.)

a. Position the circuit board assembly (20) on the shock frame base assembly (15) and fasten with two screws (16), washers (17), stand-off posts (18) and washers (19).

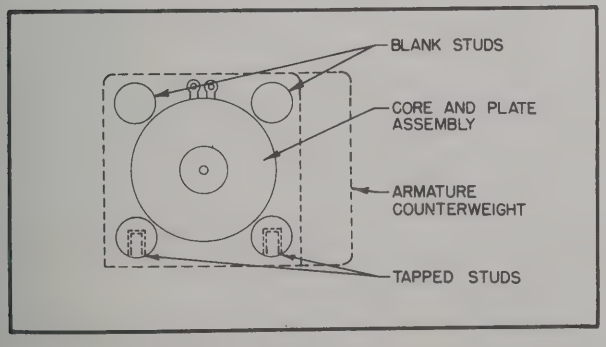


Figure 9-4. Assembling Voltage Amplifier

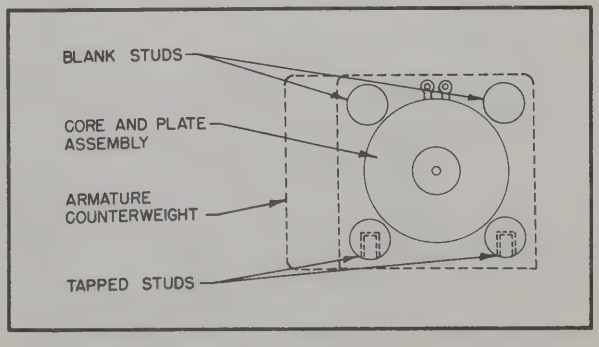


Figure 9-5. Assembling Frequency Amplifier

NOTE

The stand-off posts (18) also attach the free ends of the reactor assembly (fig. 4-3, ref. 5) and transformer (7) to the shock frame base assembly (fig. 4-2, ref. 15).

b. Assemble the frequency amplifier assembly (13) to the shock frame with three screws (11). Make the electrical connections in accordance with the wiring diagram, figure 7-2.

c. Assemble the voltage amplifier assembly (fig. 4-2, ref, 10) to the shock frame with three screws (8). Make the electrical connections in accordance with the wiring diagram, figure 7-2.

d. Assemble leads with terminals (fig. 4-2, refs. 9 and 12) to the amplifiers. Wrap a piece of friction tape around the control leads to protect the insulation from the retainer clip.

e. Assemble a grommet (fig. 4-2, ref. 14) to the leads and position the harness assembly in the clip of the shock frame base assembly (15).

f. Assemble the top frame assembly (5) to the shock frame base assembly (15) with four screws (7) and two screws (6).

NOTE

Apply Glyptal enamel, or equivalent, to the threads of the two screws (6) before reassembly.

g. Compress the shock fingers and slide the voltage and frequency control (4) into the container and friction plate assembly (3). Position the two retainer plate assemblies (1) and fasten with two screws (2) in each plate.

NOTE

The voltage and frequency control assembly must be positioned in the container and friction plate assembly so that the harness assembly extends out through the round hole adjacent to the lead clip.

h. Install the harness assembly in the lead clip of the container and friction plate assembly (3).

SECTION X

FINAL ASSEMBLY

10-1. ASSEMBLING VOLTAGE AND FREQUENCY CONTROL TO CONTROL BOX BASE ASSEMBLY. (See figure 4-1.)

a. Connect the leads from the voltage and frequency control assembly (9), marked "1", "2", "3", "4", "5", "6", "7" and "8" and to the respective markings on the terminal strip in the bottom of the control box base assembly (45).

b. Position the voltage and frequency control assembly (9) in the control box base assembly, and attach with four screws (1) and washers (11).

10-2. COMPLETING ASSEMBLY.

a. Position the AC end cover (fig. 4-6, ref. 6) on the AC shield assembly and attach with four screws (7) and washers (8).

b. Assemble the fan cover (1) to the DC end shield with two screws (2) and washers (3).

c. Assemble terminal board covers (fig. 4-1, ref. 8) to the control box base.

d. Assemble the control box lid (5) to the control box and turn the studs 1/4 turn to lock in position.

SECTION XI

DEPOT OVERHAUL STANDARDS

11-1. APPLICABILITY OF DEPOT OVERHAUL STANDARDS.

The tests outlined in this section are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

11-1.1. APPLICABLE REFERENCES.

Applicable procedures of the Army depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

11-1.2. MODIFICATION WORK ORDERS.

Perform all modification work orders applicable to the PU-573/A before making all tests specified. DA PAM 310-7 lists all available MWO's.

11-1.3. INSPECTION.

a. Inspect the general condition of the painted surfaces. They should be covered to prevent rust and corrosion.

b. Observe terminal connections They should be tight and provide good electrical contact.

c. All areas of the equipment should indicate the application of accepted shop practices.

11-2. TESTING.

11-3. TEST EQUIPMENT REQUIRED.

11-4. The test equipment listed in appendix C should be used when making test settings.

11-5. If the AN/GSM-65 is not available, set up an external power supply of 30 volts DC and a load bank as indicated in figure 11-1.

Note: Since many panel type frequency meters are sensitive to voltage and wave form, the frequency meter should be checked against a vibrating reed or tachometer. The potential leads from the wattmeter and voltmeter should be connected directly to the AC terminals of the terminal block, rather than at the load.

11-6. VOLTAGE AND FREQUENCY REGULATIONS.

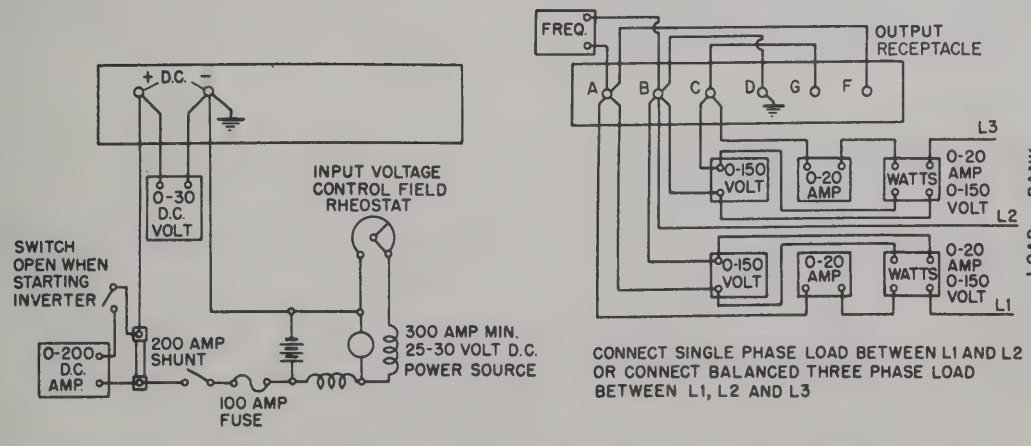
11-7. The carbon pile actuators should hold the output voltage within a range of 110-120 volts and the frequency within a range of 390 to 410 cycles with an input voltage from 26 to 29 volts DC. These results should be obtained irrespective of inverter, temperature, load, or load power factor within the rating of the machine.

11-8. Connect the inverter to the load bank and test circuit shown in figure 11-1 and proceed as follows.

Caution: Use insulated tools for making adjustments to prevent accidental short circuit.

a. Adjust the frequency range by means of the frequency rheostat (fig. 1-2, ref. 2) so that a reading of 400 cycles is obtained on the frequency meter.

b. Set voltage adjusting rheostat (fig. 1-2, ref. 6) at mid-point and start the unit. If tubes are not already warm, allow 10 seconds for warm-up. Adjust the AC voltage to 115 volts. With input voltage at 26 volts, throw full load on the unit. The AC voltage drop should be less than one volt.



IF IT IS DESIRABLE TO CHECK PHASE BALANCE, AN ADDITIONAL VOLTMETER CAN BE CONNECTED BETWEEN "A" AND "C" OR A SWITCH CAN BE ARRANGED FOR TEMPORARY CONNECTION OF THE OTHER VOLTMETER.

INVERTER PERFORMANCE IS CALCULATED FROM AVERAGE VOLTS, AVERAGE AMPS, AND TOTAL WATTS.

Figure 11-1. Load Bank and Test Circuit

c. The actuators used with these regulators are different than most familiar carbon pile regulator assemblies in that the sensing of voltage or frequency change is external to the actuator. Therefore, the position of the carbon piles and armature are less critical. Because of the close control expected from this type of regulator it is important that precise adjustments be made to permit circuit elements to follow closely a given signal. Instability may be caused by friction, foreign materials, looseness and improper mechanical or electrical balance in components. Instability is also caused by cracked, broken or burned carbon discs or contacts. Voltage instability is best observed by watching the flicker in the 6352 tube. Frequency instability can best be observed by the irregular sound and torsional vibration of the machine. Both instances of instability can best be observed on an oscilloscope connected across the AC terminals - the voltage instability appearing as a smooth, modulating wave imposed on the crests of 25 or more AC waves while the frequency instability shows up as an abrupt and sharp flutter of the AC wave form.

11-9. LOW AND HIGH AMBIENT TEMPERATURE CHECKS.

11-10. Checking regulation at inputs of 25 volts full load and 31 volts no load will generally suffice for low and high ambient temperature checks.

11-11. HEAT RUN.

11-12. Allow the inverter to run at 27.5 volts, DC input for 45 minutes under full load. Check regulation at end of run.

11-13. INPUT CURRENT.

11-14. Check input current at 27.5 volts DC. It should be approximately 68 amperes at no load and 180 amperes at full load 3 phase unity power factor. High input current can be caused by tight or rough bearings, armature rubbing stator, defective windings, or improper brush position.

11-15. STARTING RELAY.

11-16. Reduce input voltage to less than 15 volts and close the switch to the starting relay. Increase input voltage until the unit starts and note the voltage. It should be less than 18 volts. Now reduce the input volts again until the starting relay opens. Note the voltage, which should be under 7 volts. If starting relays do not meet these requirements, they should be replaced.

11-17. RUN-IN BRUSHES. Refer to paragraph 7-6.

11-18. PERFORMANCE TEST.

11-19. Refer to figure 1-3 for performance ratings when testing the inverter. All load tests should be performed at unity power factor.

a. It is not necessary to warm up the inverter prior to the performance tests if these tests are made immediately after brush run in.

b. Operate the inverter at no load. Turn the voltage adjustment rheostat through its full range. Minimum range of adjustment should be from 109 to 121 volts.

c. Repeat step (b) at full load.

d. Operate the inverter at no load. Turn the frequency adjustment rheostat through its full range. Minimum range of adjustment should be from 392 to 408 CPS.

e. Repeat step (d) at full load.

f. At no load vary the input voltage from 26 to 29 volts DC. Output voltage should not vary more than 1-1/2 volts. The frequency should not vary more than 6 CPS.

g. Repeat step (f) at full load.

h. At constant input voltage, vary load from no load to full load. Voltage variation should be less than 1-1/2 volts. Frequency variation should be less than 6 CPS.

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310-7	Military Publications: Index of Modification Work Orders.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies, and Equipment used by the Army.
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-2050	Test Set, I-48-B and Ohmmeter ZM-21A/U.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-6625-203-12	Operator and Organizational Maintenance: Multimeter AN/URM-105, Including Multimeter ME-77/U.
TM 11-6625-273-12	Operator and Organizational Maintenance: Insulation Breakdown Test Sets AN/GSM-6 and AN/GSM-6A.
TM 11-6625-303-12	Operator and Organizational Maintenance Manual: Electrical Power Test Sets AN/UPM-93 and AN/UPM-100.
TM 11-6625-535-15	Organizational, DS, GS, and Depot Maintenance Manual: Oscilloscope AN/USM-140A.
TM 11-6625-680-15	Organizational, DS, GS, and Depot Maintenance Manual: Test Set, Motor-Generator AN/GSM-65.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-316-35	Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B

BASIC ISSUE ITEMS

Section I. INTRODUCTION

B-1. General

The equipment described in this appendix is for Motor Generator PU-573/A. There are no items required for installation, operation, or operator's maintenance.

B-2. Explanation of Columns

An explanation of the columns in section II is given below.

a. Source, Maintenance, and Recoverability Codes, Column 1. Not used.

b. Federal Stock Number, Column 2. The Federal stock number for the item is indicated in this column.

c. Description, Column 3. The Federal item name, a brief description, and part number are included in this column.

d. Unit of Issue, Column 4. The unit used as a basis of issue (e.g. ea, pr, ft, yd, etc) is noted in this column.

e. Quantity Incorporated in Unit Pack, Column 5. Not used.

f. Quantity Incorporated in Unit, Column 6. Not used.

g. Quantity Authorized, Column 7. The total quantity of an item required to be on hand and necessary for the operation and maintenance of the equipment is given in this column.

h. Illustration, Column 8. Not used.

SECTION II. BASIC ISSUE ITEMS LIST

(1) (A) SOURCE CD	(1) (B) MAINT. CD	(1) (C) REC. CODE	BASIC ISSUE ITEMS LIST (2) FEDERAL STOCK NUMBER	MODEL 1	2	3	4	5	6	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS (A) FIGURE NUMBER	(8) ILLUSTRATIONS (B) ITEM OR SYMBOL NUMBER
			6125-578-8130							MOTOR GENERATOR PU-573/A: Output data, ac; 400 cycles, 2,500 va rating 115 v; 3 phase; input data, 24 vdc; 13-5/8 in lg X 6-7/8 in w X 9-1/2 in h; MIL spec MS-25097-2; (This item is nonexpendable)	ea			1		

NO PARTS AUTHORIZED USER, OPERATOR, CREWMAN

NO ACCESSORIES, TOOLS, OR TEST EQUIPMENT ARE TO BE ISSUED WITH THIS EQUIPMENT

NO BASIC ISSUE ITEMS ARE MOUNTED IN OR ON THIS EQUIPMENT

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Motor Generator PU-573/A. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Group numbers correspond to the reference designation prefix assigned in accordance with ASA Y32.16, Electrical and Electronics Reference Designations. They indicate the relation of listed items to the next higher assembly.

b. Component Assembly Nomenclature. This column lists the item names of component units, assemblies, subassemblies, and modules on which maintenance is authorized.

c. Maintenance Function. This column indicates the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	Maintenance Category
C	Operator/Crew
O	Organizational Maintenance
F	Direct Support Maintenance
H	General Support Maintenance
D	Depot Maintenance

d. Tools and Equipment. The numbers appearing in this column refer to specific tools and equipment which are identified by these numbers in section III.

e. Remarks. Self explanatory.

C-3. Explanation of Format for Tool and Test Equipment Requirements

The columns in the tool and test equipment requirements chart are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	MOTOR-GENERATOR PU-573/A	O	O	O	O			O	O	F	H	D	1 thru 18	
1	INVERTER	O	F	O	O			F	F	F	H	D	1 thru 16	
	ARMATURE ASSEMBLY	F	F	F				F	F	H	H	D	4 thru 16	
	STATORS		F					H	H	H		D	4 thru 16	
	BEARINGS	F						F	F				9	
	END BELL ASSEMBLIES	F	H	F	H			H	H	H	H	D	9	
	BRUSHES	O		F	F			F	F				9	
2	REGULATOR	O	O	O	O			F	F	F	H	H	1 thru 6,9, 16 thru 18	
	CONTROL GROUP	F	F	F	F			F	F	F	H	H	4 thru 6,9, 16 thru 18	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
		PU-573/A (continued)		
1	O	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/U	5180-610-8177	
2	O,F	TEST SET, ELECTRICAL POWER AN/UPM-93	6625-581-2097	
3	O	MULTIMETER AN/URM-105	6625-581-2036	
4	F,H,D	TEST SET, MOTOR GENERATOR AN/GSM-65	6625-348-5793	
5	F,H,D	OSCILLOSCOPE AN/USM-140A	6625-892-4401	
6	F,H,D	MULTIMETER TS-352/U	6625-242-5023	
7	F,H,D	BRIDGE, RESISTANCE ZM-4B/U	6625-500-9037	
8	F,H,D	TEST SET, ARMATURE TS-965/U	6625-828-5810	
9	F,H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/U	5180-605-0079	
10	F,H,D	BRUSHES, DUMMY		
11	D	DYNAMIC BALANCING MACHINE		
12	D	LATHE		
13	D	OHMMETER ZM-21A/U	6625-581-2466	
14	D	TEST SET INSULATION BREAKDOWN AN/GSM-6	6625-868-8326	
15	D	VIBROMETER	6635-494-1553	
16	D	ANALYZER, SPECTRUM TS-723( )/U	6625-668-9418	
17	D	TEST SET, ELECTRON TUBE TV-2/U	6625-699-0263	
18	F,H	TEST SET, ELECTRON TUBE TV-7/U	6625-820-0064	

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
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Chief of Staff.

Official:

KENNETH G. WICKHAM,
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